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CHAPTER 11
RECLAIMED WATER SYSTEM

11.00.00 INTRODUCTION

All reclaimed water distribution systems constructed within the CITY of Westminster shall comply with the requirements of these STANDARDS AND SPECIFICATIONS and may include additional special standards established by the CITY for overall hydraulics of the reclaimed water utility system. Special standards shall be outlined at pre-design meetings, as determined necessary by the CITY ENGINEER.

In the case of reclaimed water mains larger than 12 inches, the owner or his representative shall submit construction specifications and drawings to the CITY for review and approval prior to the CITY's approval of the PLANS.

All references to standards and manuals shall refer to the most current edition unless noted otherwise.

11.01.00 INTERRUPTION OF SERVICE

The CITY's Utilities Operations Division will operate all existing valves, blow-offs and curb stops. **No valve or other control device on the existing public system will be operated for any purpose by anyone other than the Public Works & Utilities Department.** Twenty-four hours prior to the interruption of service, the CONTRACTOR shall notify all users whose the CITY's Public Works Utilities Operations Division and affected customers. No interruptions may last longer than three days without prior written approval from the CITY ENGINEER.

In certain situations to lessen the impacts to adjacent customers (e.g. residences, businesses, schools, etc.), the WORK detailed in this section may require night or weekend construction at the direction of the CITY ENGINEER.

11.02.00 RECLAIMED WATER BREAKS

If notification prior to shutdown is impossible, the CONTRACTOR shall notify the CITY's PWU Operation Division and affected customers within one hour after the shutdown.

11.03.00 METER SET INSTALLATION REINSPECTION FEE

Water tap fees provide for the initial inspection of the meter set only. Where additional inspections are made necessary by incomplete or faulty work, a fee in accordance with CITY CODE will be charged for the second inspection and each subsequent inspection. This fee shall be charged to the holder of the permit and paid to the CITY before any additional inspections will be made.

To schedule an inspection during regular business hours, contact the Utility Operations Division Meter Shop at 303 658-2549. For after hours emergencies call Police dispatch at 303 658-4360.11.10.00

DESIGN STANDARDS

11.11.00 SCOPE

It is the intent of this "design standards" section to provide sufficient detailed information to enable the Engineer for the Owner/Developer to correctly and efficiently design the overall reclaimed water system for a particular development. If there is a question or a concern regarding the design of any portion of the reclaimed water system that is not adequately answered within this chapter, the owner/developer or his representative shall contact the CITY to get all issues resolved prior to design. Any deviation from these STANDARDS AND SPECIFICATIONS must be approved in writing by the CITY ENGINEER.

11.12.00 GENERAL

The reclaimed water system shall be designed by or under the direct supervision of a Professional Engineer registered in the State of Colorado utilizing the most current technical standards along with good, sound engineering judgment throughout the design process. The engineer shall have experience in the design and construction of municipal reclaimed water distribution systems. The development approval process includes the submittal of a Preliminary Development Plan, an Official Development Plan, utility study and construction drawings for review and approval by the CITY ENGINEER. The reclaimed water system designs shall be reviewed by the Reclaimed System Analyst and Utilities Engineering Group in the Public Works Department prior to final approval.

The reclaimed water system utility studies may be combined with the potable water and sanitary sewer utility studies.

11.12.01 Reclaimed Water System Utility Study Requirements

The Utility Study shall include the following information and shall be bound in an 8 ½ x 11 inch folder:

1. **Certification statement** - shall be included at the beginning of the report and shall read as follows: "This Utility Report for the design of the ____ development was prepared by me or under my direct supervision in accordance with the City of Westminster's Standards and Specifications and acceptable professional practices of the industry. We acknowledge that the City of Westminster's review of this Utility Study is only for general conformance with submittal requirements, current design standards and standard engineering principles and practices. We are also aware of the provisions of Section 11-6-5(B) of the Westminster Municipal Code." The seal and signature

of the Professional Engineer responsible for preparing the report shall follow this statement.

2. **Report text** for the water system design shall include the following at a minimum:
 - a. **Project location and Description** – a description of the boundary streets, project area and type of development proposed or anticipated use. Include a vicinity map.
 - b. **System layout** – a description of the existing and proposed reclaimed water infrastructure in conformance with the CITY's latest master plan shall be provided and reference shall be made to a figure in the back of the report illustrating these improvements. The description shall include the sizes and types of existing and proposed pipes and the influence of the improvements on the project and surrounding area.
 - c. **Design flow requirements** - Complete design flow calculations and a discussion explaining the calculations and assumptions shall be provided.
 - d. **Hydraulic Analysis** - Hydraulic analysis may be required. Contact the Reclaimed System Analyst in Public Works to determine the need and parameters for hydraulic analysis. If modeling is required, minimum and maximum flow conditions will need to be modeled. Model results shall be presented in a table format. A figure indicating pipe and junction labels shall be provided.
 - e. **Conclusions** – a description of the results and how they follow the CITY standards shall be provided. Any deviations from the CITY standards shall be described and applicable variances requested.
 - f. **Appendices** - Printed data output from the modeling results shall be provided in the appendix and shall correspond with a figure of the pipe and node network. The appendix shall also include flow test results, hand calculations and any other pertinent data. A large size figure (11" x 17" or larger) illustrating the existing and proposed utility improvements shall be provided and shall conform to the CITY's latest reclaimed water master plan. The drawing shall include pressure zone boundaries, elevation contours and locations of proposed and existing utility easements and right-of-way.

In situations where a previous utility study was conducted and is still applicable, a utility conformance letter may be submitted in place of the Utility Study, at the discretion and with written authorization of the CITY ENGINEER.

11.13.0 DESIGN DEMAND

The irrigation demands for a particular development vary depending on the type of landscape. The peak irrigation demand shall be determined by the irrigation designer. Peak week, peak day, and peak hour shall be estimated and provided to the CITY ENGINEER.

The CITY ENGINEER shall be consulted for design standards with regard to non-standard developments, design of municipal infrastructure such as transmission mains, pump stations, etc. and for development with unusually high demands. The CITY ENGINEER shall have final input in these instances.

11.14.0 HYDRAULIC DESIGN

The CITY ENGINEER shall be contacted to determine if a model is required. If required, a computer generated hydraulic analysis of the proposed infrastructure, or "model," shall be developed using industry standard software such as WaterCAD or CITY approved equal. The model shall be based on the CITY's latest Reclaimed Water Master Plan. Contact the Reclaimed Water Analyst in the Public Works department for design standards and Master Plan information. Transmission mains and laterals may be oversized for future buildout, see Section 11.17.02. These guidelines are a baseline, and the CITY ENGINEER reserves the right to review and approve designs.

For purposes of hydraulic modeling, Hazen Williams C coefficient shall be 130 for PVC pipe, lined ductile iron pipe, and lined steel pipe. For any other condition, coordination with the PWU Department is required.

11.15.00 OPERATING PRESSURES WITHIN THE DISTRIBUTION SYSTEM

For specific design pressures associated with the reclaimed water system, the Reclaimed Water Analyst must be contacted prior to beginning system design efforts.

11.16.00 PRESSURE REGULATING STATIONS

Pressure reducing valve (PRV) installations should be avoided. In areas where a main extension may cause pressures to be greater than the existing zone pressure, the DEVELOPER must discuss alternatives with PWU. Detailed design of any PRV installations shall be performed by the developer's engineer with input from Public Works.

For individual reclaimed water service lines, water pressure regulators will be required if system pressures exceed 80 psi or at the discretion of the CITY ENGINEER.

11.17.00 SIZING OF MAINS

11.17.01 Distribution Mains

All reclaimed water mains shall be sized large enough to provide for irrigation flows to the area serviced. The maximum pipe velocity shall be 7 feet per second. Final size of distribution mains shall be in accordance with the CITY's most recent reclaimed water system master plan, and approved in writing by the CITY. In some circumstances, the reclaimed water system would be extended to service a new development, but would not yet be constructed to full build-out as shown in the master plan. If in this case, the pipe size needed for the development is smaller than the pipe size shown in the master plan, the CITY will pay for the cost differential of the pipe, subject to the CITY ENGINEER's written approval.

11.17.02 Transmission Mains

All transmission mains shall be sized in order to meet the demand at peak irrigation, as sized in the CITY's latest reclaimed water system master plan, or as otherwise approved in writing by the CITY. See section 11.22.00 for further details. In some circumstances, the reclaimed water system would be extended to service a new development, but would not yet be constructed to full build-out as shown in the master plan. If in this case, the pipe size needed for the development is smaller than the pipe size shown in the master plan, the CITY will pay for the cost differential of the pipe, subject to the CITY ENGINEER's written approval.

11.18.00 SYSTEM LAYOUT - CONSTRUCTION PLAN STANDARDS

11.18.01 General

All reclaimed water mains shall be installed in dedicated RIGHT-OF-WAY or public easements. Reclaimed waterlines should NOT be installed parallel to and directly below any concrete such as sidewalks, curbs, or gutters. Location of lines within the street shall be as directed by the CITY ENGINEER.

The minimum depth of cover for reclaimed water mains from the final approved grade of the surface to the top of the reclaimed water main shall be 5 feet. Where final grades have not been established, mains shall be installed to a depth great enough to insure 5 feet of cover below the approved future grade but in no event less than 5 feet of cover from the temporary grade. The maximum depth of cover for reclaimed water mains shall be 8 feet below the final approved grade of the surface unless approved otherwise, in writing, by the CITY ENGINEER.

Plan and profile shall be required for all reclaimed water main designs. Utility crossings shall be identified in the profile views for all known or planned utilities. The vertical alignment of reclaimed water mains shall be designed

such that unnecessary high points are avoided. If a high point in the main cannot be avoided, a controlled high point shall be located at a fire hydrant tee where trapped air in the system can be bled. High points at a reclaimed water main lowering should be avoided by deflecting the main on both sides of the lowering such that positive pipe grades are maintained to controlled high points in the system. To maintain positive pipe grades to controlled high points, the maximum depth of cover to the main can increase to 8 feet, if approved in writing by the CITY. Refer to Sections 3.18.02 and 3.18.06 for the alignment of water lines with sewer lines. Refer to Section 3.18.07 for the design of combination air valves.

Reclaimed water mains shall be laid a minimum of ten feet, horizontally and edge to edge, from any existing or proposed utility. Upon written approval by the CITY, a water main may be laid closer than ten feet to a parallel sewer main if it is laid in a separate trench and if the elevation of the invert of the reclaimed water main is at least 18 inches above the crown of the sewer main and, in addition, PVC C-900 is used for the sewer main.

Reclaimed water mains shall be designed such that they extend the entire frontage of the property to be served or as otherwise approved in writing by the CITY.

In all cases, valves shall be located on either side of such crossings so that the reclaimed water main can be completely isolated for convenience in maintenance and repair.

The Standard Reclaimed Water Notes found on the CITY website shall be included on all reclaimed water construction plans and documents.

11.18.02 Reclaimed Waterline Crossing Over A Sanitary Sewer Line

Reclaimed waterline crossings over sanitary sewer lines shall be evaluated with the same standards as potable waterline crossings over sanitary sewer lines. When there is less than 18 inches of vertical clearance between the water main and the sanitary sewer pipe, or water main pipe joints extend less than 10 feet each side of the sewer pipe, one of the following secondary containments shall be required for the water or sewer pipe:

- 1) Utilize Pressure Pipe AWWA C900 for the sanitary line.
- 2) Utilize concrete or flowable fill encasement, extending to any joints within 10 feet of the crossing.

If joint-less pipe, such as fusible PVC or welded steel, is used for the water or sanitary sewer pipe then secondary containment will not be required. However, structural support of the water or sewer main using flowable fill may be required to prevent settlement and permit maintenance of both utilities.

Minimum criteria is presented in this section, and applies to both public mains and private service lines.

11.18.03 Reclaimed Waterline Crossing Over A Storm Sewer Line

Reclaimed waterline crossings over storm sewer lines shall be evaluated with the same standards as potable waterline crossings over storm sewer lines. When there is less than 18 inches of vertical clearance between the reclaimed water main and the storm sewer. Freeze potential of a reclaimed water main shall be evaluated when crossing storm sewers or other exposures to the elements. If a water main crosses a storm sewer with 3 feet or less of vertical clearance, a 12" thick layer of extruded polystyrene insulating foam, also referred to as "XPS" shall be provided all around the water main for a minimum of 5 feet on each side of the storm sewer. The sheets of "XPS" shall be thick enough to allow shaping of the material so it fits snugly around all sides of the pipe leaving a minimum 12" thickness around all sides of the pipe. Bonding of individual sheets of "XPS" shall be in accordance with Chapter 3 of these STANDARDS AND SPECIFICATIONS. Crossings of dead end reclaimed water mains and storm sewer with less than 18 inches of vertical clearance shall be prohibited.

11.18.04 Reclaimed Waterline Crossing Over a Potable Water Line

In all cases, regardless of vertical clearance, the reclaimed water line shall be encased in concrete a minimum of nine feet on each side of the centerline of the crossing or PVC pressure pipe in accordance with AWWA C900, pressure class 305 psi may be used for the reclaimed water line.

11.18.05 Sanitary Sewer Line Crossing Over a Reclaimed Waterline

Sanitary sewer line crossings over reclaimed waterlines shall be evaluated with the same standards as sanitary sewer line crossings over potable waterlines. When there is less than 18 inches of vertical clearance between the water main and the sanitary sewer pipe, or water main pipe joints extend less than 10 feet each side of the sewer pipe, one of the following secondary containments shall be required for the water or sewer pipe:

- 1) Utilize Pressure Pipe AWWA C900 for the sanitary line.
- 2) Utilize concrete or flowable fill encasement, extending to any joints within 10 feet of the crossing.

Note that if joint-less pipe, such as fusible PVC or welded steel, is used for the water or sanitary sewer pipe then secondary containment will not be required. However, structural support of the water or sewer main using flowable fill may be required to prevent settlement and permit maintenance of both utilities.

Minimum criteria is presented in this section, and applies to both public mains and private service lines.

11.18.06 Storm Sewer Line Crossing Over a Reclaimed Waterline

Storm sewer line crossings over reclaimed waterlines shall be evaluated with the same standards as storm sewer line crossings over potable waterlines. In all cases, regardless of vertical clearance, the joints of the storm sewer shall be encased in concrete a minimum of nine feet on each side of the centerline of the crossing.

Freeze potential of a reclaimed water main shall be evaluated when crossing storm sewers or other exposures to the elements. If a water main crosses a storm sewer with 3 feet or less of vertical clearance, a 12" thick layer of extruded polystyrene insulating foam, also referred to as "XPS" shall be provided all around the water main for a minimum of 5 feet on each side of the storm sewer. The sheets of "XPS" shall be thick enough to allow shaping of the material so it fits snugly around all sides of the pipe leaving a minimum 12" thickness around all sides of the pipe. Bonding of individual sheets of "XPS" shall be in accordance with Chapter 3 of these STANDARDS AND SPECIFICATIONS. Crossings of dead end reclaimed water mains and storm sewer with less than 18 inches of vertical clearance shall be prohibited.

11.18.07 Potable Waterline Crossing Over a Reclaimed Waterline

When there is less than 18 inches of vertical clearance between the potable water line and the reclaimed water line, the reclaimed water line shall be encased in concrete a minimum of nine feet on each side of the centerline of the crossing or PVC pressure pipe in accordance with AWWA C900, pressure class 305 psi may be used for the reclaimed water line.

11.18.08 Limits On Vertical Separation

Under no circumstances shall the vertical clearance between any reclaimed water, potable water, sanitary sewer, or storm sewer pipe be less than 18 inches without written approval from the CITY ENGINEER.

11.18.09 Combination Air Valves

Combination air valves are necessary to serve several functions: they exhaust large volumes of air from the system during start-up, they open during draining or if a negative pressure occurs and they release accumulated air from the system during operation. At depressions of the reclaimed water system, a combination air valve is required on each side of the depression for this reason. The vertical alignment of Reclaimed Water mains shall be designed such that unnecessary high points are avoided as described in Chapter 3 of these STANDARDS AND SPECIFICATIONS. If a high point in a

reclaimed water main cannot be avoided, an air valve shall be located at the high point and within a manhole.

Combination air valves for distribution mains and transmission mains shall be sized by the DEVELOPER in accordance with the manufacturer's recommendations and approved by the CITY ENGINEER.

11.19.00 EASEMENTS

All reclaimed water mains shall be in an easement which has a horizontal width of at least two times the depth to the pipe invert. The minimum easement shall be 20 feet in width for one utility, 30 feet in width for two utilities, and 40 feet in width for three utilities. Site-specific circumstances may dictate the need for wider easements. For normal depths, the main shall be located a minimum of 10 feet from and parallel to the edge of the easement. Meters not installed within the RIGHT-OF-WAY will require an easement dedication ten feet wide and extending five feet behind the meter. If water meter extends behind the curb more than ten feet, then the width of the easement shall be a minimum of 15 feet. All easements shall be for the exclusive use of the CITY. Neither landscaping (except grass and private irrigation systems) nor permanent structures (sheds, buildings, etc.) shall be placed in the easement.

The easement agreement, provided by the CITY, shall state that any temporary structures (including paving and fencing) placed in the easement shall be removed and replaced by the OWNER when requested by the CITY so that maintenance can be performed. The OWNER shall agree to hold the CITY harmless for any replacement of structures removed from the easement.

The following statement shall appear on all Official Development Plans and all final plats.

UTILITY MAINTENANCE STATEMENT

All public water, reclaimed water, storm sewer and sanitary sewer mains and appurtenances located in public RIGHT-OF-WAY shall be maintained by the CITY PWU Department. All public water, reclaimed water, storm sewer, sanitary sewer mains and appurtenances under private drives are located in utility easements. CITY is responsible for maintenance of these water, reclaimed water, storm and sanitary sewer facilities. CITY is not responsible for repair or replacement of private drive, curb and gutter or landscaping damaged during utility repair or maintenance.

11.20.00 FUTURE CONNECTIONS

A blow-off shall not be installed at the end of any reclaimed water main which terminates and is anticipated to be extended in the future, except at the direction of the CITY ENGINEER. When a future main extension is anticipated, the main shall include valves so that only one valve will have to be closed when the main is extended. The valve shall be restrained so when the one valve is closed and the line to be extended is exposed, the valve will not blow off. Restraint shall be made by the

use of a mechanical joint anchoring tee (swivel tee), swivel cross, and by installing a minimum of two full lengths of pipe on the extension side of the valve (8 inch pipe and smaller). No service taps shall be allowed on a main which can be extended in the future between the single valve to be closed and the dead end.

11.21.00 SERVICES

Calculations for meter and service line sizes shall be prepared using information from the CITY PWU Department Water Resources Analyst and Reclaimed Water Analyst. The calculations will be based on the irrigated area, type of turf, number of zones, water requirements and restrictions, and other pertinent information in accordance with Section 8-12-5(A) of the CITY CODE. The applicant shall prepare plans and calculations and submit them to the Reclaimed Water Analyst for review and approval. The Water Resources Analyst and Reclaimed Water Analyst must approve all meter and service line sizes (before and after the meter) prior to beginning construction. The service lines, tap and meter shall be the same size, unless otherwise approved and/or required by the CITY ENGINEER. If the tap and meter are of different sizes, the fee shall be paid based on the larger size, unless a larger tap is approved and/or required by the CITY ENGINEER in which case the fee for the meter size shall be paid. Refer to the Reclaimed System Analyst, PWU, with any questions.

Each development with areas serviced with reclaimed water is required to have a separate reclaimed water tap and meter from the reclaimed water main, in accordance with Section 8-12-6(A) of the CITY CODE. Each owner shall have a separate meter, unless a business association is formed. In that instance, the association would be the owner of the meter. The business association must be finalized before the Notice of Authorization (NOA) can be issued.

Utility easements shall be required for service lines up to and including the meter pit.

No pressure booster facility of any kind shall be allowed on any service line between the public main and the meter. All service line pressure booster facilities shall be privately owned and maintained.

Reclaimed water service lines shall be located a minimum of 10 feet away from all other services, unless an exception is approved by the CITY. All service lines shall be constructed perpendicular to the front property line of the property to be served and not less than 5 feet from the side of a front property line. New service lines through private property to serve a separate property are prohibited.

Size changes, if allowed between the service line and the meter, shall be accomplished by providing a full sized meter vault and setter for the line size installed and using industry standard adapters to install a reduced size meter in the full size line.

Reclaimed water taps cannot be issued prior to a NOA issue by the State of Colorado.

11.22.00 TRANSMISSION MAINS

All water mains larger than 12 inch in diameter shall be classified as "transmission mains."

All transmission mains shall have combination air valves installed at all high points on the line and on each side of butterfly valves in accordance with the Standard Details in the Appendix of this Chapter.

Only purple PVC pipe is approved for reclaimed water main installations 12 inches in diameter and smaller. Lines 20 inches in diameter and larger may be purple colored ductile iron pipe or steel pipe, as approved in writing by the CITY ENGINEER. A Hazen Williams C coefficient of 130 shall be used when modeling PVC and DIP pipe and shall be 100 for steel pipe, unless otherwise approved in writing by the CITY.

The design of ductile iron and steel transmission mains and other critical direct bury appurtenances such as valves, shall require cathodic protection. Cathodic protection shall be designed by a qualified Cathodic Protection Engineer, registered in the State of Colorado and shall conform to NACE Standard RP-01-69, latest revision. As a minimum, the cathodic protection system shall include magnesium anodes; test station thermal board and shunts; exothermic weld caps and coating; conductor, test stations, joint bond wires; wire splice kits; exothermic weld equipment and materials; wire and cable marker tags; and one-piece insulating sleeves and washers, all in conformance with these STANDARDS AND SPECIFICATIONS. All of the data for these materials shall be submitted to the CITY for approval prior to installation. Test stations shall be shown on design drawings and as-built drawings. Cathodically protected pipe, except steel casing pipe, shall also require polyethylene wrap as described in these STANDARDS AND SPECIFICATIONS.

No service line taps or any taps less than six inches in diameter shall be made to transmission mains. Exceptions to this will be for combination air valves only.

Valves of transmission mains shall be placed no more than 800 feet apart, unless an exception is approved in writing by the CITY ENGINEER. Where there are connections to transmission mains, all connecting mains shall include valves at the connection. There shall be a minimum of two valves at a tee connection and three valves at a cross connection.

11.23.0 UNLAWFUL CONNECTION

No installation of reclaimed water supply piping or part thereof shall be made in such a manner that it will be possible for used, unclean, polluted, or contaminated water, mixtures, or substances to enter any portion of such piping from any tank, receptacle, equipment, or plumbing fixture by reason of back siphonage, suction, back pressure, or any other cause, either during normal use and operation or when any such tank receptacle, equipment, or plumbing fixture is flooded, or subject to pressure in excess of the main line operating pressure. No person shall make a connection or allow one to exist between pipes or conduits carrying domestic water supplied by the CITY and any pipes, conduits, or fixtures containing or

carrying water, chemicals, liquids, gases, or any other substances from any other source. Refer to Chapter 3 of these STANDARDS AND SPECIFICATIONS, Backflow Prevention Assemblies for further requirements.

The purpose of **purple** pipe, detectable tape, and polyethylene encasement (poly wrap) material for reclaimed water systems is to assist in prevention of cross connections between potable and reclaimed water systems. The color purple is required by CITY CODE and is required for compliance with State of Colorado Regulation 84.

11.24.00 APPURTENANCES

11.24.01 Valves

Valve placement shall be such that there are at least two valves at every tee and three valves at every cross. Valves 16 inch or larger shall be butterfly valves. Main line valves shall be located at a tee, cross or elbow if possible. Under no circumstances shall a valve be located in concrete areas, such as sidewalks, crosspans, aprons, curbs, or gutters. Butterfly valve operators shall be located on the north or east side of the water main. Any valve located in a greenbelt area shall have an 18-inch-wide by 6-inch thick concrete collar around the valve box. All 16" and larger butterfly valves will be accessible in a vault.

11.24.02 Fire Hydrants

No fire hydrants are allowed on the reclaimed water system.

11.24.03 Thrust Blocks and Joint Restraint Devices

All bends, tees, plugs, dead-ends, wet taps (in certain cases), hydrants, and blow-offs shall be designed and constructed with concrete thrust blocks. If the soil-bearing strength is unknown, the soil-bearing capacity used in design shall be 2,000 pounds/square foot. Refer to the detail drawings in the Appendix of this chapter.

Joint restraint devices shall be used on both sides of valves and fittings for pipe sizes 12 inches in diameter and smaller and in addition to thrust blocks. Vertical bends in all pipe sizes shall be restrained using joint restraint devices and shall be restrained for a specified distance as recommended using the latest edition of AWWA Manual M23 and M41, as appropriate.

Harness rods, or "rodding", are not an acceptable means for restraining pipe and fittings unless it is specified inside vaults as shown on the detail drawings in the appendix of this Chapter. Under no circumstance shall steel harness rods be allowed to be in contact with soils.

11.24.04 Meters

Calculations for meter and service line sizes (before and after the meter) shall be prepared using the sizing information available from the CITY PWU Water Resources Analyst. The applicant shall prepare plans and reclaimed water demand calculations and submit them to the CITY Water Resources Analyst for review and approval. The CITY Water Resources Analyst must approve all meter and service line sizes prior to beginning construction. The service lines, tap and meter shall be the same size, unless otherwise approved and/or required by the CITY ENGINEER. If the tap and meter are of different sizes, the fee shall be paid for the larger, unless a larger tap is approved and/or required by the CITY ENGINEER in which case the fee for the meter size shall be paid.

Inspections of all meter pits or vaults shall be conducted by the CITY ENGINEER. Locations and details for pits or vaults shall be reviewed and approved in writing by the CITY ENGINEER.

11.24.05 Fire Protection Service Line

No fire protection service lines are allowed on the reclaimed water system.

11.24.06 Valve Vaults

All valves larger than 12 inches shall be installed in a vault in accordance with the Standard Details in the Appendix of this Chapter. All valve vaults shall be capable of withstanding AASHTO H-20 highway loading. The vault shall also have lift hooks in the roof for valve removal inside the vault.

Vaults shall be made water proof after construction by use of sealants, epoxies or other approved methods. All vaults shall be designed with wall sleeves and link seal and be capable of handling thrusts caused by removing valves. All vent pipes for vaults shall be installed in conformance with the Standard Details in the Appendix of this Chapter.

11.24.07 Manholes

Manholes shall be installed on all pressure regulating valves, all butterfly valves, permanent blow-off installations, and air release valves in accordance with the Standard details in the Appendix of this Chapter.

11.24.08 Backflow Prevention Assemblies

To prevent backflow contamination of the CITY potable water system, a reduced pressure zone backflow prevention device shall be used for all non-residential irrigation services. This shall be required for both domestic and reclaimed water sources. The assembly shall be located a minimum of five feet downstream of the water meter and installed per CDPHE guidelines and Section 8-7-27 of the CITY CODE to allow for proper operation and easy access for annual testing and maintenance.

11.30.00 **CONSTRUCTION SPECIFICATIONS**

11.31.00 **TRENCHING, BACKFILLING AND COMPACTION**

Trenching, backfilling and compaction shall be done in accordance with Chapter 9 of these STANDARDS AND SPECIFICATIONS.

11.32.00 **BEDDING**

In the event unstable trench conditions are found at pipeline grade, a minimum of one and one-half inch uniformly graded, washed rock shall be used for trench stabilization. Depth of the stabilization shall be as approved in writing by the CITY ENGINEER.

Granular bedding material shall meet the requirements of Chapter 9 of these STANDARDS AND SPECIFICATIONS. Bedding shall be placed to six inches below the bottom of the pipe and shall be placed around the sides of the pipe and to a minimum of 12 inches above the top of the pipe and in accordance with the Standard Details the Appendix of this Chapter.

11.33.00 **PIPELINE INSTALLATION**

11.33.1 **General**

The CITY shall be notified at least 48 hours in advance of any pipe installation. No pipes shall be backfilled until they have been inspected by the CITY. Alignment and grade of the pipe and the location of fittings, valves, and hydrants shall be staked in accordance with the approved construction plans under the supervision of a Professional Land Surveyor registered in the State of Colorado.

Proper implements, tools, and facilities shall be provided and used by the CONTRACTOR for the safe and convenient execution of the work. All pipe fittings, valves, and hydrants shall be carefully lowered into the trench by means of a derrick, ropes, or other suitable tools or equipment to prevent damage to water main materials and protective coatings and linings. Chains or cables shall not be used for handling pipe with protective coatings. Under no circumstances shall water main materials be dropped or dumped into the trench.

All pipe and fittings shall be carefully examined for cracks and other defects immediately before installation. The groove in the bells of the pipe shall be full and continuous or the pipe will be rejected. Defective pipe or fittings shall be removed from the job site within 24 hours of notification by the CITY ENGINEER. All foreign matter or dirt shall be removed from the interior and ends of pipe and accessories before they are lowered into position in the trench and prior to connection.

Every precaution shall be taken to prevent foreign material and trench water from entering the pipe and fittings. During construction, the CONTRACTOR

shall provide and maintain adequate equipment to properly remove and dispose of all water entering the trench and any other part of the work.

11.33.02 Pipe

Immediately before joining two lengths of pipe, the inside of the bell and the outside of the spigot end and the gasket shall be thoroughly cleaned. Caution shall be exercised to ensure that the correct type of gasket is used. A thin film of gasket lubricant shall be applied to the inside face of the gasket and the spigot end of the pipe. The spigot end of the pipe shall be placed in the bell with care to prevent the joint from contacting the ground. The joint shall be completed by pushing the pipe home with a slow steady pressure, without jerky or jolting movements. Pipe furnished without a depth mark shall be marked before assembly to ensure insertion to the full depth of the joint. The pipe shall then be properly set and brought to correct line and grade. After installation of the polyethylene protective wrap, if required, the pipe shall be secured in place by installation of bedding material and backfill, in accordance with Chapter 9 and the detailed drawings in the Appendix of this chapter. All pipe laying shall be in accordance with AWWA C600 and AWWA C605.

Deflection from a straight line or grade, as required by horizontal or vertical alignments or offsets, shall not exceed fifty percent (50%) of the maximum allowable limits set by the manufacturer's specifications. If the alignment requires deflection in excess of the allowable deflection per joint, special bends, or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limits set forth, as approved, in writing, by the CITY ENGINEER.

All fittings, appurtenances and ductile iron pipe shall be protected with minimum 8 mil polyethylene film wrap in accordance with these STANDARDS AND SPECIFICATIONS. Additionally, approved wax taping and zinc caps shall be placed on all bolted fittings. Miscellaneous steel or other ferrous pipe for temporary blow-offs, etc., shall be similarly protected. Methods for applying the wrap shall conform to the Standard Details in the Appendix of this Chapter.

At times when installation is not in progress, the open ends of the pipe shall be closed with a watertight plug. Pipe should be kept clean, dry, and supported off the surface of the ground. Cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining, leaving a smooth end at right angles to the axis of the pipe. Pipe ends shall be smooth and beveled with a file or other tools according to the pipe manufacturer's recommendations.

Extra care should be used in handling PVC pipe during cold weather due to the reduced flexibility and impact resistance as temperatures approach and drop below freezing. PVC pipe to be stored outside and exposed to sunlight for more than 30 days shall be covered with an opaque material such as

canvas. Clear plastic sheets shall not be used to cover the pipe. Air circulation shall be provided under the covering. Any over-exposed pipe, as determined by the CITY ENGINEER, will not be permitted for installation.

All PVC waterline installations shall include the installation of a single, 12-gauge, insulated copper tracing wire taped to the top of the pipe. The tracing wire shall be installed in a continuous run between manholes and meters, and the ends of the tracer wire shall be brought to the surface in a cathodic protection box in accordance with the detail drawing in the Appendix of this chapter. Wire splices shall be accomplished in accordance with the detail in the Appendix of this chapter. Tracer wire shall be tested by the CITY ENGINEER, or by the CONTRACTOR and observed by the CITY ENGINEER, for continuity prior to acceptance.

During the backfilling of all PVC reclaimed waterline trenches, a continuous 2-inch-wide metallic-coated, detectable tape labeled "Reclaimed Waterline Buried Below" shall be placed in the trench backfill 2 feet above and directly over the pipe. Detectable tape shall be manufactured by Pro-Line, or CITY approved equal.

Following backfill and compaction of the water mains, cathodic protection test stations, shall be tested for effectiveness by the CONTRACTOR and the results of the continuity test shall be submitted to the CITY ENGINEER. If cathodic protection of the pipe is determined not to meet industry standards, then corrections shall be made until it meets industry standards and is accepted by the CITY ENGINEER.

11.33.03 Fittings

Pipes shall be connected to valves and fittings by mechanical joints unless specified differently in the approved drawings. For approved slip-on joints, the joint shall be assembled with a ratchet jack or other approved method in a manner that does not cause any damage to the pipe. Both the spigot and bell must be thoroughly clean and free from tar or other coatings and rust.

For mechanical joint pipe, the last 8 inches of the outside of the spigot end of the pipe and the inside of the bell of all fittings and gate valves shall be thoroughly cleaned to remove oil, grit, tar (other than standard coating), and other foreign matter from the joint and then a thin film of gasket lubricant shall be applied. The cast iron gland shall then be slipped on the spigot end of the pipe with the lip extension of the gland toward the bell of the fitting. Gasket lubricant shall be applied to the rubber gasket and placed on the spigot end of the pipe with the thick edge towards the gland.

After the spigot end of the pipe is placed into the bell and fully inserted the gasket shall be pressed into place within the bell so it is even around the entire joint. After the gland is positioned behind the gasket, the CONTRACTOR shall install all bolts and nuts and tighten them with a torque wrench in accordance with manufacturer's recommendations. Nuts spaced

180 degrees apart shall be tightened alternately to produce equal pressure on all parts of the gland. All fittings must have approved zinc caps and wax tape.

Jointing shall be done in accordance with AWWA Specification C-111, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings, for all mechanical joint fittings.

11.34.00 VALVE AND VALVE BOX INSTALLATIONS

In addition to the jointing requirements mentioned in Chapter 3 of these STANDARDS AND SPECIFICATIONS, the additional requirements of this section shall apply. Valves and valve boxes shall be installed where shown on the PLANS and as directed by the CITY ENGINEER. Valve boxes shall be firmly supported, centered, and plumbed over the operating nut of the valve with the box cover at or minus 1/4-inch within the surface of the finished pavement or at such other elevation as may be directed by the CITY ENGINEER. Extensions to within 4 feet of the finished grade shall be provided for valves installed with more than 5 feet of cover. All extensions shall be pinned to the valve operating nut. Earth fill shall be carefully tamped around each valve box to a minimum distance of 4 feet on all sides of the box, or to the undisturbed trench face if less than 4 feet. Valves shall have the interiors cleaned of all foreign matter before and after installation. For valve box installations in flow fill, pipe wrap must be used on the exterior of the valve box.

Gear cases shall be tightened and the valve shall be inspected in opened and closed positions to insure that all parts are in working condition prior to installation. The cases shall be supported by concrete blocks to prevent any shock or stress being transmitted to the valve.

11.35.00 THRUST BLOCKS

The CONTRACTOR shall excavate as required to ensure that the thrust blocks are placed against undisturbed soil and shall form the sides of the thrust block to provide the size and shape as required in the Standard Details in the Appendix of these STANDARDS AND SPECIFICATIONS. When it is impossible, because of over excavation or other causes, to pour a thrust block against undisturbed earth, harness rods shall be used to anchor the fittings to the main in addition to the thrust block and as required by the CITY ENGINEER. After the concrete has been placed and has set, the CONTRACTOR shall remove all forming materials prior to backfilling around the thrust block. Concrete for the thrust blocks shall comply with provisions set forth in Chapter 7 of these STANDARDS AND SPECIFICATIONS

The blocking shall be placed so that the pipe and fitting joints will be accessible for repair. A bond breaker shall be placed between the fittings and the thrust block. Backfill may be placed over the thrust blocks once the surface has set sufficiently to resist the weight of the backfill. However, no tamping or compacting shall be allowed above the thrust block for a minimum of 24 hours after placement. Concrete must set a minimum of 48 hours prior to the initial filling of the line.

11.36.00 CONNECTION TO EXISTING MAINS

At locations where connections to existing water mains are to be installed, the CONTRACTOR shall locate the existing mains, both vertically and horizontally, and shall verify their exact size in advance of the time scheduled for making the connections. The CONTRACTOR shall notify and schedule the connection with the CITY ENGINEER.

Prior to connecting to existing water mains, the CONTRACTOR shall have all personnel, materials, and equipment ready to connect the fitting to the existing main to keep the shut-off time to a minimum. As soon as possible after making the connections, the CONTRACTOR shall flush the connection to prevent any contamination of the existing facilities. The CONTRACTOR shall take every precaution necessary to prevent dirt or debris from entering the main. CONTRACTOR must use AWWA standards C651 and C655 for disinfection and flushing for all new water mains. Refer to PWU current approved service rules for detail on disinfection, flushing, testing, and connections.

11.37.00 FIRE HYDRANT INSTALLATION

No fire hydrants are allowed on the reclaimed water system.

11.38.00 TAPS

The size of tap and the tapping method for a given type and size of waterline shall be as follows. Transmission mains (16 inch pipes and larger) should not be tapped unless otherwise approved in writing by the CITY ENGINEER.

Host Pipe Size	Tap Size (DIP or PVC)			
	¾"	1"	1-1/2"	2"
6"	DT/S	DT/S	S	S
8"	DT/S	DT/S	S	S
10"	DT/S	DT/S	S	S
12"	DT/S	DT/S	S	S

S -- Tapping saddle required. All saddles shall have the AWWA taper on its threads.

DT -- Direct tap permitted.

DT/S -- Either a tapping saddle or a direct tap may be permitted depending on the situation.

All existing AC waterlines shall be tapped using a saddle.

¾" and 1" taps into the water main shall be at an angle of 45 degrees from the horizontal, and corporation stops shall be installed. 1 1/2" and 2" taps into the water main shall be at the 3 and 9 O'clock position, and corporation stops installed.

Taps shall not be made on a water main until the main has passed the pressure tests and clear water tests and a "Release For Service" letter has been issued by the CITY ENGINEER. Care shall be taken to properly install water service lines so that a

minimum of 12 inches of slack is in the service line at the main to protect against pull-out. Tapping mains may require digging out bedding material and cutting or removing part of the corrosion protective wrapping. After the taps are made, the wrap shall be repaired or replaced by the CONTRACTOR to protect both the service line and the main.

Service taps shall have a minimum separation of 24 inches and be no closer than 24 inches to a main line joint. There shall be no more than 4 taps per 20' section of pipe.

All service taps shall be performed by the CONTRACTOR. All necessary materials for said taps, including corporations stops, copper line, meter pits, copper setters, curb stops, etc., shall be supplied by the CONTRACTOR. Said materials shall conform to these STANDARDS AND SPECIFICATIONS. The CITY ENGINEER will inspect each tap prior to backfilling.

Taps to PVC mains shall be accomplished with the mainline valves either side of the tap in the closed position.

Taps to PVC mains shall only be made when the air temperature is 32°F or higher.

11.39.00 METER INSTALLATION

All meter installations shall be in accordance with the Standard Details in the Appendix of this Chapter.

No connections shall be made in the meter pit other than those related to the meter and bypass. Sprinkler system or backflow preventer connections shall be made no closer than five (5) feet from the meter pit or vault on the downstream side of the meter. The CITY will own and maintain the service line and fittings up to, and including the meter.

Residential 5/8" x 3/4" meters with transponders shall not be allowed on the reclaimed water system. All other meters and associated transponders shall be purchased by the CONTRACTOR and then provided to the CITY for testing prior to installation. The CONTRACTOR shall contact the CITY's Meter Shop prior to purchasing meters and transponders to verify the type and brands that are required. The CONTRACTOR shall also contact the CITY's Meter Shop to make an appointment for delivery of said meter(s) to the Shop for testing. The location of installation and manufacturers information shall accompany the meter when delivered by the CONTRACTOR to the CITY. The meter will be tested and CONTRACTOR must call to schedule the meter pit/vault inspection. In addition, the following specific standards shall apply:

11.39.01 3/4-Inch and 1-Inch Meter Installations

The ¾" and 1" meter sets are not allowed on the reclaimed water system.

11.39.02 1-1/2-Inch and 2-Inch Meter Installations

The 1 ½" and 2" meter sets shall be installed in accordance with these STANDARDS AND SPECIFICATIONS and the Standard Details in the appendix of this Chapter. Meter manhole lids shall be a maximum of 2 inches above the approved final grade.

The meter manhole shall be located a minimum of 3 feet behind sidewalk and in no case shall the manhole lid be located more than 10 feet from the back edge of curb. Where no sidewalk exists, the meter shall be placed a maximum of 6 feet behind the back of curb. In detached walk areas the meter shall be placed 6 feet behind the back edge of curb but no closer than 18 inches from the front edge of the walk to the edge of the meter lid. A curb stop is required on the service line behind the back of curb and outside of the manhole. In all cases, the meter manhole shall be installed within the RIGHT-OF-WAY or public Utility Easements. No meter manholes shall be set in streets, concrete areas, driveway alignments, or other traffic area without specific design and prior approval of the CITY ENGINEER.

Meter manholes shall use a 24 inch aluminum ring and cover and the outside of the aluminum ring shall have 8 mils of tar applied. Once the tar is set then a 12" wide by 6" thick concrete collar shall be placed around the manhole ring. The manhole cover shall have a 2 inch diameter recessed hole in the center of the cover for the transponder and the cover shall have the lettering "Reclaimed Water Meter" cast into the lid. Meter manholes in traffic areas are only allowed at the discretion of the CITY ENGINEER. If allowed, the manhole shall use a 24 inch aluminum ring and cover and shall be designed to accommodate and protect the transponder. Approval by the CITY ENGINEER of this design will be on a project specific basis.

11.39.03 3-Inch and Larger Meter Installations

The 3" and larger meter sets shall be installed in accordance with these STANDARDS AND SPECIFICATIONS and the Standard Details in the Appendix of this Chapter. The entry hole through the roof of the vault shall be aligned perpendicular to the service line and adjacent to the water meter. Vaults shall be sealed at all joints and made watertight. Meter vault lids shall be a maximum of 2 inches above the approved final grade.

The meter vault shall be located a minimum of 5 feet behind sidewalk or back of curb and no more than 10 feet from the back of curb. Where no sidewalk exists, the meter shall be placed a maximum of 6 feet behind the back of curb. In detached walk areas the meter shall be placed 6 feet behind the back

edge of curb but no closer than 18 inches from the front edge of the walk to the edge of the meter lid. A curb stop is required on the service line behind the back of curb and outside of the vault. In all cases, the meter vault shall be installed within the RIGHT-OF-WAY or public Utility Easements. No meter vaults shall be set in streets, concrete areas, driveway alignments, or other traffic area without prior approval of the CITY ENGINEER.

Meter vaults shall use a 24 inch aluminum cover and shall have the lettering "Reclaimed Water Meter" cast into the lid. A 24" x 36" aluminum cover adaptor and ring shall be used to enlarge the access opening and the adaptor shall have a 2 inch diameter hole for the transponder.

The outside of the aluminum ring shall have 8 mils of tar applied. Once the tar is set then a 12" wide by 6" thick concrete collar shall be placed around the manhole ring. Meter manholes in traffic areas are only allowed at the discretion of the CITY ENGINEER. Approval by the CITY ENGINEER of the design for traffic areas will be on a project-specific basis.

PVC pipe shall be used on the service line outside the vault, except where the pipe stubs through the vault walls. DIP shall be used inside the vault. For all 3 inch and 4 inch meter settings, 4 inch service pipe will be required on the CITY side of the meter. A reducer will be required before the meter and on the bypass for 3 inch settings. Insulators shall be provided between connections of dissimilar metals. Meter installations larger than 3 inch and larger shall require shop drawing submittals for approval.

Final inspections of the meter manhole will be made at the time the meter is set. Meter will be set by the CONTRACTOR if the meter manhole passes inspection. CONTRACTOR must call 303-658-2549 to schedule final inspection. CONTRACTOR will warranty meter manhole and appurtenances for a period of 2 years after final inspection has passed.

11.40.00 TESTS

11.40.01 General

The CONTRACTOR shall flush and test all mains regardless of existing conditions. This may include repairing existing facilities that must be included in the test and are not capable of holding test pressures. All thrust blocks or other bracing facilities shall be in place at least 48 hours before the initial filling of the line. All tests will be observed by the CITY ENGINEER.

11.40.02 Filling and Venting Lines

All valves will be operated by the Public Works & Utilities Department. The line shall be slowly filled with water and all air expelled from the pipe. Care shall be taken so that all available hydrants (including hydrant gate valves),

air valves, and other vents are open during the filling of the line. Where hydrants or other vents are not available in the line, the CONTRACTOR shall make whatever taps are required for venting purposes. These taps shall be abandoned after pressure and disinfection tests have passed and the line has been completely flushed as required by the Public Works Department. Following testing, the taps shall be removed back to the main and the main repaired by the use of a stainless steel repair clamp. The rate of filling the line shall not exceed the venting capacity of the vent.

11.40.03 Disinfection

The disinfection test is not required for reclaimed water systems.

11.40.04 Flushing the Main

The entire line shall be flushed with potable water after installation is complete. Such flushing shall continue until the water is clear, the line is flushed appropriately, and per direction of the CITY. The entire line, including branch lines and dead-end mains shall be flushed. The discharge of flushed water shall be accomplished such that no erosion will occur and with no harm to fish, animals, or plants in accordance with Federal and State regulatory agencies.

The Water Quality Control Division of the CDPHE requires all water line CONTRACTORS to possess a current Discharge Permit for discharges of chlorinated and process waters associated with the installation of new mains or conduits. Contact CDPHE Water Quality Control Division at 303-692-3539 for information on obtaining the required permit. Procedures for discharge will be subject to the review of the CITY ENGINEER.

11.40.05 Pressure Test

After the pipe and appurtenances have been laid, the line has been backfilled, disinfection and flushing of the system has occurred and all field-place concrete has cured in accordance with these STANDARDS AND SPECIFICATIONS each valved section, unless otherwise directed by the CITY ENGINEER, shall be subjected to a hydrostatic pressure of not less than 150 psi. However, in all cases the test pressure shall be 50 percent over existing main pressure in the test area as measured at the lowest elevation of the water main. The test duration shall be a minimum of one hour. If the test pressure drops more than 5 p.s.i. during the test, measured water shall be added to the test section to bring the section up to the specified test pressure. Water added to maintain the pressure shall be per AWWA C600-05 and AWWA C605-05. Allowable leakage shall be calculated according to the following formula:

Ductile Iron and PVC Pipe:

$$L = \frac{N \times D \times \text{SQRT}(P)}{148,000}$$

L = Allowable Leakage in gallons per hour
N = Total length of pipe being tested in feet
D = Nominal diameter of pipe in inches

P = The average test pressure in psi

Each test section of pipe shall be slowly filled with water and the specified test pressure (measured at the lowest point of elevation) shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, gauges, and all necessary apparatus and labor shall be furnished by the CONTRACTOR. Gauges and measuring devices shall be approved by the CITY ENGINEER. Before applying the specified test pressure all air shall be expelled from the pipe. Any cracked or defective pipes, fittings, valves, or hydrants discovered in the pressure test shall be removed and replaced by the CONTRACTOR with sound material including any existing pipe or appurtenances that are leaking and were included in the test section. After all visible leaks have been repaired; the pressure test shall be conducted again. Should testing show a leakage rate in excess of the rates calculated from the formula above, the pipeline shall not be accepted. The pipeline shall be repaired and retested as described in this section until it meets the test requirements and is accepted by the CITY ENGINEER.

11.40.06 Bacteriological and Turbidity Test

The bacteriological test is not required for reclaimed water systems.

Water from all new reclaimed water mains and appurtenances must successfully pass a turbidity test before the main is placed in service. After final flushing, an acceptable sample shall be collected from the new mains and appurtenances. A sample shall be collected for every 800 feet of new pipe.

All sampling shall be performed by the CITY ENGINEER.

11.40.07 Cathodic Protection System Testing

Following construction of water mains and other appurtenances requiring cathodic protection, the following tests shall be performed:

1. Test the pipe-to-soil voltage potential by comparing to a copper sulfate half-cell. One lead of the volt meter is connected to the pipe lead and the other is connected to the copper sulfate half cell buried in moist

in-situ soil near the pipe installation. The potential shall read 0.85 volt or higher. A value of 0.80 volts or less means the pipe is corroding.

2. Check the continuity of the pipe. Prior to completely backfilling the pipe an ohmmeter shall be connected between each end of the installed pipe to measure an ohm reading. Next, test between the test box lead wire and the pipe. A reading of 3 ohms or less shall be achieved for both tests.
3. Test the voltage output of the anode. As in test one above, connect the voltmeter to the anode lead wire and the other lead to the copper sulfate half cell. The voltage reading shall be between 1.4 and 1.6 volts.
4. Measure the current flow from the anode to the pipe. The volt meter is connected to the anode test lead and the other voltmeter lead is connected to the pipe test lead in the test box. The reading shall be between 0.005 amp and 0.3 amp. If the current is more than 1.3 times the design needs, a resistance shall be added to the circuit to extend the life of the anodes.

11.40.08 Cross Connection Test

The CITY requires all new and retrofit sites to pass a cross connection test upon being connected to the reclaimed water system, and the site must pass the test before the site can receive final approval. The completion and cost of the test shall be the CONTRACTOR's responsibility. Pass or fail shall be determined by the CITY ENGINEER, and a CITY INSPECTOR and/or Reclaimed Water System Analyst shall be present for the cross connection test.

The test shall be by one of two methods: (1) injection of dye into the irrigation system or (2) completion of a shutdown test. The CITY reserves the right to select the test method.

The dye test consists of injecting dye through the backflow device and moving the dye around the site by opening irrigation valves or utilizing quick couplers. Once the dye is in place, the CONTRACTOR operates multiple outlets of the site's potable water system (e.g. hosebibs, faucets, drinking fountains, etc) for 3-5 minutes each to check for dye in the water. If dye is detected in the potable system, then the test reveals a cross connection.

The shutdown pressure test consists of shutting off the potable water source and testing for any changes in pressure in that system, then testing the reclaimed water source similarly. First, the potable source on site is shut off. Add pressure gauges to the system or open hose bibs/faucets. If there is no pressure increase as measured by the gauges, or there is no flow from the hose bibs/faucets, then the potable water is restored. The same process is repeated for the reclaimed system to check for any increases in pressure in that system. If one or both of the checks fail, then the test reveals a cross connection.

If the chosen test reveals a cross connection, the CONTRACTOR shall be responsible for any and all repairs needed to eliminate the cross connection. The CONTRACTOR shall then repeat the cross connection test at the CONTRACTOR's expense until no cross connection is found.

11.50.00 MATERIALS

11.51.00 GENERAL

In accordance with CITY CODE, only purple colored PVC pipe shall be approved for reclaimed water distribution main installations. Any other material proposed must be approved by the CITY ENGINEER in writing, prior to construction. All materials furnished shall be new and undamaged. Transmission mains, 16 inches in diameter and larger, may be purple colored ductile iron pipe or steel pipe at the discretion of the CITY ENGINEER.

Acceptance of materials or the waiving of inspection thereof shall in no way relieve the DEVELOPER of the responsibility for furnishing materials meeting the requirements of these STANDARDS AND SPECIFICATIONS. The CITY reserves the right to direct or deny the use of certain types of materials in specific circumstances. All materials delivered to the job site shall be adequately housed and protected to ensure the preservation of their quality for the work. The presence of any defects in any materials may constitute sufficient cause for rejection of the pipe or appurtenances. Rejected materials shall be removed from the work site unless otherwise permitted by the CITY ENGINEER.

11.52.00 PIPE

11.52.01 Ductile Iron Pipe (DIP)

All ductile iron pipe shall be manufactured in accordance with AWWA Standard C-151 current standard (include zinc coated pipe), Ductile Iron Pipe Centrifugally Cast for Water. Pipe furnished under this specification shall conform to pressure class 350.

Ductile iron pipe shall be approved for fire hydrant laterals, pipe stubs through walls (as required) and other applications as approved by the CITY CITY ENGINEER in writing.

The joint type shall be "push-on, single-gasket" type conforming with applicable requirements of AWWA Standard C-111 current standard, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings. Joint types other than "push-on, single-gasket" are acceptable only if specifically approved by the CITY ENGINEER in writing.

Pipe shall have normal laying length of either 18 feet or 20 feet. Random lengths are not acceptable.

Grade of Iron used in the manufacture of pipe shall have 60/42/10 physicals in accordance with AWWA C-151.

Pipe shall have standard thickness cement mortar linings in accordance with AWWA Standard C-104-13, Cement Mortar Lining for Ductile Iron Pipe and Fittings. Pipe shall have a standard asphaltic coating on the exterior

The weight, pressure class or nominal thickness, and casting period shall be shown on each pipe. The manufacturer's mark, the year in which the pipe was produced, and the letters "DI" or

"Ductile" shall be cast or stamped on the pipe. IAW AWWA C-151 current standard.

11.52.02 Polyvinyl Chloride Pipe (PVC)

All PVC pipe shall meet the requirements of AWWA Specification C-900 current standard, Polyvinyl Chloride Pressure Pipe and Fabricated Fittings (4" - 12"), and shall be Pressure Class 305 psi (DR 14), or AWWA C-905 current standard, Polyvinyl Chloride Pressure Pipe and Fabricated Fittings (14" - 48"), and shall be Pressure Class 235 psi (DR 18).

All pipe shall be suitable for use as a pressure conduit. Provisions must be made for expansion and contraction at each joint with a rubber ring. The bell shall consist of an integral wall section with a solid cross-section rubber ring which meets the requirements of AWWA Specification C-900 current standard.

Standard laying lengths shall be twenty feet (20') for all sizes. Random lengths shall not be acceptable.

Each length of pipe shall bear the date manufactured, type, grade, length, manufacturer's name, and NSF seal of approval.

Pipe joints shall be made using an integral bell with an elastomeric gasket push-on type joint or using machined couplings of a sleeve type with rubber ring gaskets and machined pipe ends to form a push-on type joint.

Solvent cement joints are strictly prohibited.

The manufacturer shall furnish a certified statement that all of the specified tests and inspections have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the CITY ENGINEER upon request.

The following test station box has been approved by the CITY for use with tracer wire installations:

Valvco, Terminal Box #NM (5" ID) without locking lid

Others as approved in writing.

11.52.03 Steel Pipe

Upon approval by the CITY ENGINEER, the use of steel pipe may be allowed for transmission mains 16 inches in diameter or larger. The pipe shall meet Standard AWWA C-200 current standard, Steel Water Pipe 6 inch and Larger, and installed accordingly. Detailed specifications shall be as approved by the CITY ENGINEER on a case-by-case basis.

All new steel mains shall require cathodic protection and shall be designed by a qualified Cathodic Protection Engineer, registered in the State of Colorado. Cathodically protected pipe shall also require polyethylene wrap as described in section 11.61.02.

11.53.00 FITTINGS

All mechanical joint fittings shall be manufactured in accordance with AWWA C110 current standard, Ductile Iron and Gray Iron Fittings, or AWWA C153 current standard, Ductile Iron Compact Fittings. Fittings shall be furnished with rubber gasket joints in accordance with AWWA C111 current standard, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.

All fittings shall be 350 PSI pressure rating and shall conform to the dimensions and weights shown in the tables of the above referenced AWWA Standards. All fittings shall be made from gray iron or ductile iron. The manufacturer shall prepare a certified statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable Standard(s) herein specified. A copy of the certification shall be sent to the CITY ENGINEER upon request.

All ductile iron flanged fittings shall be manufactured in accordance with AWWA C110 current standard for integrally cast flange fittings or AWWA C115 current standard, Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges, for threaded flange fittings. Typical ductile iron flanged fittings shall be rated for 250 psi working pressure. A working pressure of 350 psi may be achieved with the use of special gaskets.

The following are additional requirements or exceptions to the standards mentioned above:

All fittings 4" through 16" shall be furnished with a fusion bonded epoxy inside and out, with a standard thickness as defined in AWWA C116 current standard , Protective Fusion Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings. The requirement for fusion bonded epoxy on fittings may be waived by the CITY ENGINEER if specific fittings are not available.

All fittings shall be furnished complete with tee-head mechanical joint bolts and hexagon nuts and shall be fabricated from a high strength, low alloy steel known in the industry as "Cor-Ten" or approved equal.

Mechanical joint anchoring fittings (swivel) as approved by the CITY ENGINEER, in writing, may also be used.

11.54.00 VALVES

11.54.01 General

All valves shall open left (counterclockwise). Valves shall have a 2-inch-square operating nut. Extension stems shall be pinned to the operating nut for a secure connection. Set screw type connections will not be allowed.

All buried valves shall be installed with a valve box meeting the material specifications of these STANDARDS AND SPECIFICATIONS.

11.54.02 Gate Valves

Gate valves shall be required for 4 inch through 12 inch valve sizes, unless approved otherwise by the CITY ENGINEER in writing. Gate valves shall be iron body, resilient-seated gate valves with non-rising bronze stems with design, construction, and pressure ratings conforming to AWWA Specifications C-509 current standard, Resilient Seated Gate Valves, or C515 current standard, Reduced Wall Resilient Seated Gate Valves, and with modifications specified herein. Stem seals shall be triple "O" ring seals designed so that the seals above the stem collar can be replaced with the valve under pressure and in full open position.

Gate valves approved by the CITY shall be one of the following types:

American Flow Control, Series 2500 (C515 only)
Mueller, Series 2361, 2362
American AVK, Series 25, 45, 65
CLOW Valves, Models 2639 and 2640

With the exception of tapping valves and valves in vaults, gate valves shall have mechanical joint ends.

Gate valves requiring flanged ends shall have dimensions and drilled holes that conform to ANSI B16.1, Class 125. Flange faces shall be machined to a flat surface with a serrated finish in accordance with AWWA C207 current standard, Steel Pipe Flanges (4 in. through 144 in). Tapping valves and valves in water vaults for 3" and larger meters shall have a flange connection on one side of the valve and a mechanical joint on the other side (refer to section 3.60.04 for approved tapping valves).

All ferrous internal and external surfaces of the valves shall be epoxy coated in conformance with AWWA C116 current standard, Protective Fusion Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings, and C550 current standard, Protective Interior Coatings for Valves and Hydrants. The coating shall be a two-part thermosetting epoxy suitable for field over coating and for touch-up with the same coating material without special surface preparation. The supplier shall furnish detailed performance tests of adhesion, hardness and abrasion resistance of the furnished coatings when requested by the CITY ENGINEER. The coating shall have a successful record of performance in valves, pipe or other fittings for a minimum of ten years.

The resilient seat gate valve stem shall have external break-off capabilities for over-torquing and positive stop to prevent over compression.

All external bolts, nuts and washers used in conjunction with valves shall be stainless steel and tee-bolts shall be "Cor-Ten" with zinc caps. Valves shall be delivered complete with bolts, glands and rubber gaskets in conformance with AWWA C111 current standard, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.

11.54.03 Butterfly Valves

Butterfly valves shall be required for 16 inch and larger valves, unless approved otherwise by the CITY ENGINEER in writing. All butterfly valves shall be installed in a vault in accordance with the Standard Details in the Appendix of this Chapter. Butterfly valves shall have a combination air and vacuum valve installed on both sides of the valve.

Butterfly valves approved by the CITY shall be one of the following types:

Mueller, Lineseal III and XP11 (sizes up to 48")
Pratt, Triton XR-70 (sizes 24" to 72"),
K-Flo, 500 Series (sizes up to 20")

Butterfly valves shall be geared and designed for underground service and shall conform to current AWWA Specification, Rubber Seated Butterfly Valves, Class 150-B. Valves shall be tight closing rubber seat type with the rubber seats bonded to the valve body. No metal to metal sealing surfaces will be permitted. Valves shall be bubble tight to 150 PSI minimum rated pressure with flow in either direction. Valve discs shall rotate 90 degrees from the full open position to the shut-tight position. Valve bearings shall be sleeve-type corrosion-resistant, and self-lubricating with the load not to exceed 2,500 PSI.

All butterfly valves shall be furnished with flanged ends. Dimensions and drilling shall conform to ANSI B16.1, Class 125. Flanges shall be machined to a flat surface with a serrated finish in accordance with AWWA C207 current standard, Steel Pipe Flanges (4 in through 144 in). The flanges shall have full-sized bolt holes through the flanges, except that drilled and tapped holes will

be acceptable only in the areas where the shaft passes through the body. Flanges with all holes tapped will not be allowed.

All ferrous internal and external surfaces of the valves shall be epoxy coated in conformance with AWWA C116 current standard, Protective Fusion Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings, and C550 current standard, Protective Interior Coatings for Valves and Hydrants.

All external bolts, nuts and washers used in conjunction with valves shall be stainless steel and tee-bolts shall be "Cor-Ten".

11.54.04 Valve Boxes

Valve box lids shall be triangular and marked with the words "RECLAIMED WATER," and shall have a lip or flange extending into the valve box shaft. No slip-type boxes will be allowed.

Valve box lids for buried gate valves shall be the following type or CITY ENGINEER approved equal:

East Jordan Iron Works, No. COM120120A01

11.55.00 FIRE HYDRANTS

Fire hydrants shall not be installed on reclaimed water lines.

11.56.00 BLOW-OFFS

Blow-offs shall not be installed on reclaimed water lines, except per the direction of the CITY ENGINEER.

11.57.00 MANHOLES AND VAULTS

11.57.01 General

Manholes, Vaults and associated components (i.e. manhole sections, lids, walls and base slabs) shall be designed in accordance with ASTM C 857 and ASTM C 858 to handle applicable loads, including earth, thrust and live loads. Concrete shall have a minimum 28 day mix design of 5,000 psi. All concrete structures shall be designed for HS-20 loading in accordance with AASHTO Standards. Concrete structures shall be manufactured by facilities certified by the National Precast Concrete Association (NPCA). Concentric reducing sections for manholes shall not be used.

Vaults shall be cast with a separate roof slab for removal and shall be 8 inches minimum thickness. Vault walls shall be cast in one continuous placement and corners shall have added reinforcement as shown in the standard detail in the appendix of these Standards and Specifications. Minimum wall thickness shall be 6

inches and reinforcement shall be at least one inch from the face of the vault. Shop drawings for vault designs shall be submitted to the CITY ENGINEER and shall be signed and sealed by a Professional Engineer registered in the State of Colorado.

Steps shall be ½" minimum diameter steel reinforcing bar with a polypropylene plastic covering. Steps shall be placed 12 inches on center and 18 inches maximum from the top of the ring to the first step. Steps shall align with one another in a straight vertical line. Steps shall be PS2-PF manufactured by M.A. Industries, Inc., or CITY approved equal.

11.57.02 Rings and Covers

All gray iron manhole rings and covers shall conform to the requirements of AASHTO M 105 Class 35B or ASTM A48 Class 35B. Ductile Iron castings shall conform to the requirements of ASTM A536 Grade 80-55-06. Aluminum castings shall conform to the requirements of ASTM B 26 Alloy 356 or 319. All castings shall conform to Federal Specification RR-F-621E, for shape and dimension required and shall have a minimum traffic load rating of AASHTO H20-44.

Each casting shall have markings by the foundry showing: name of foundry, country of manufacture, AASHTO or ASTM designation number, Class number and letter and cast date. Lids shall have lettering, and CITY logo, as shown in the detail drawings in the appendix of this chapter. CITY logo is required on all castings except valve box covers and meter pit lids for meters 2 inch and smaller.

Castings shall be free from plugging, sand, blowholes, shrinkage, cracks, and other cold shuts and be well cleaned by shot blasting. Runners, risers, fins, and other cast-on pieces shall be removed from the castings and ground smooth. Bearing surfaces between manhole rings and covers shall be cast or machined with such precision that a uniform bearing surface shall be provided throughout the perimeter area of contact.

Covers shall be 23-7/8" in diameter and frame or ring height shall be 5-1/4" tall in accordance with the standard detail in the appendix of these Standards, or as otherwise approved in writing. Concrete extension collars shall be used to adjust the manhole ring and cover to approved street or ground surface.

Gray iron ring and covers shall be the following type or CITY approved equal:

East Jordan Iron Works, Product No. 00245511 (36" diameter hub)
East Jordan Iron Works, Product No. 00245521 (36" diameter outer cover)
East Jordan Iron Works, Product No. 00240588 (24" diameter inner lid)

Aluminum rings and covers shall be the following type or CITY approved equal:

11.57.03 Base Slabs and Base Beams

When required, manhole base beams shall be precast, reinforced concrete. The beams shall be 12 inches wide by 9 inches deep by 8 feet long. The reinforcement shall consist of three No. 5 bars longitudinally and No. 4 bars at 12-inch centers transversely.

Base slabs may be poured in place or precast. The slab shall be designed to uniformly support AASHTO H-20 traffic loading and any earth loading. The minimum slab thickness shall be 6 inches. The minimum reinforcement in the base slab shall conform to the detail drawings in the Appendix of this chapter.

11.57.04 Joint Material

Joint material used to join all sections shall be a flexible butyl resin joint sealing compound meeting Federal specifications SS-S-210-A and AASHTO M-198-B. Joint material shall be Ramnek, or CITY approved equal.

11.57.05 Mortar

Mortar used in repair of precast sections and for grouting joints shall be composed of one part Portland cement and not more than three nor less than two parts of fine aggregate. Hydrated lime or masonry cement shall not be used. Portland cement shall meet the requirements of ASTM C-250, Type II. Fine aggregate shall consist of well-graded natural sand having clean, hard, durable, uncoated grains, free from organic matter, soft or flaky fragments or other deleterious substances. The fine aggregate shall be thoroughly washed and shall be uniformly graded from coarse to fine with a minimum of 95 percent passing a No. 4 sieve and a maximum of 7 percent passing a No. 100 sieve.

11.58.00 VAULT ELECTRICAL AND MECHANICAL

Electrical and mechanical panels shall be installed in a cabinet above ground in a convenient location. The panels shall be designed and installed per the direction of the CITY ENGINEER.

11.59.00 VENT PIPES

For typical above ground vent pipe installations, vent pipes shall be 3-feet tall and 8-inch diameter seamless pipe in accordance with the details in the appendix of these Standards and Specifications.

Below-ground, vent pipes shall be 6-inch diameter, SDR 35 or Schedule 40 PVC in accordance with the details in the appendix of these Standards and Specifications.

11.60.00 SERVICE CONNECTIONS

11.60.01 Pipe

Acceptable material for 1/2" and 2" service lines is seamless copper tube and for 4" and larger service lines PVC pipe shall be used. All service pipes shall conform to one of the following specifications.

- (A) Seamless copper tube designated as "Type K" (soft) in the industry shall be used for 1-1/2" and 2" service lines. Service pipe and fittings 1-1/4" in diameter are prohibited. Seamless copper tube service pipe shall be installed with purple colored poly wrap per Section 11.61.02.
- (B) PVC pipe conforming to Chapter 3 of these STANDARDS AND SPECIFICATIONS shall be used for 4-inch and larger service lines. Three-inch service pipe is not readily available and service pipe specified as 3-inch shall be upsized to 4-inch from the main connection to the meter pit.

11.60.02 Saddles

For 1 1/2" and 2" taps requiring saddles, the saddles shall be AWWA taper thread (CC thread) and shall be manufactured in accordance with AWWA C-800 current standard, Underground Service Line Valves and Fittings. Cast saddle top, strap, and nuts shall be constructed of ASTM A-536 Class 65-45-12 stainless steel.

The following saddles have been approved for use with ductile iron, cast iron, AC or PVC host pipes, 6" through 12":

	1 1/2"	2"
McDonald	----- 3825 Series -----	
Ford	----- FC202-905 Series -----	
Mueller	----- BR2B Series -----	
Ford (stainless)	----- FS202-905-Series -----	

11.60.03 Curb Stop Valves and Curb Stop Boxes

All curb stops shall be manufactured in accordance with AWWA C800 current standard, Underground Service Line Valves and Fittings, and shall be constructed of brass in accordance with ASTM-B62. Curb stop valves shall be ball type with a maximum working pressure of 300 psi and shall have compression fittings.

Curb stop valves for use with copper service pipe shall be the following type:

	1 1/2"	2"
McDonald	6100Q	6100Q

Ford	B44-666-G	B44-777-G
Mueller	B-25209	B-25209

All curb stops shall have a valve box per 11.54.04 of this section.

11.60.04 Tapping Sleeve and Valve

Tapping sleeves shall be required on existing host pipe for all taps larger than 2 inch, unless a tee is provided.

Cast or Ductile Iron Host Pipe

Full body Mechanical Joint (MJ) cast or ductile iron tapping sleeves are required.

Tapping sleeves for Cast Iron or Ductile Iron shall be the following type:

Mueller H-615
 Waterous Series 1004 or 2800
 US Pipe T-9
 Tyler/Union Compact (up to 12")

PVC or AC Host Pipe

Fabricated stainless steel triangular sidebar style with stainless steel flange tapping sleeves are required. No coated carbon steel saddles will be allowed. A flange insulator kit between the valve and sleeve is required. Stainless steel bolts will be required on the tapping sleeve side of the valve. Tapping sleeve shall be rated for 250 PSI minimum operating pressure (sizes 4"-12") and 200 PSI minimum operating pressure for larger sizes.

Tapping sleeves for PVC or AC host pipes shall be the following type:

JCM 432 or 452
 Mueller H-304
 Ford FTSS
 Romac SST III or STS 420
 Smith Blair 665

Steel Host Pipe

Weld on Saddles shall be required. These taps are application specific and require approval by the CITY ENGINEER.

Tapping valves shall be resilient seat, cast iron or ductile iron body, fully bronze mounted with non-rising stem and shall be in conformance with section 3.54.02 of these Standards and Specifications. Tapping valves shall have a flange connection on one side meeting the requirements of ANSI B16.1 Class 125 and a mechanical joint on the other side meeting AWWA C111

current standard, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings. Valves shall be delivered complete with bolts and gaskets.

Tapping sleeves for Steel host pipes shall be the following type or CITY approved equal:

- Mueller, Series 2360 (sizes 4" - 12")
- American AVK, Series 45 (sizes 4" - 12")

11.60.05 Corporation Stops

All corporation stops and threaded brass fittings shall be manufactured in accordance with AWWA C800 current standard, Underground Service Line Valves and Fittings, and shall be constructed of brass in accordance with ASTM-B62. All corporation stops shall be tested at the factory and shall meet the following minimum physical requirements:

Tensile strength	30,000 PSI minimum
Yield Strength	14,000 PSI minimum
Elongation in 2 inches	20 percent minimum

Corporation stops shall be ball valve type designed for a maximum working pressure of 300 psi. The inlet side shall have AWWA taper thread (CC thread) and the outlet side shall have a compression fitting.

Corporation stops shall be the following type:

	1½"	2"
McDonald	----- 4701BQ ----- ---	
Ford	FB1000-6-G	FB1000-7-G
Mueller	----- B-25008 ----- ---	

11.60.06 Stop and Waste

Stop and waste valves must be approved by CITY ENGINEER.

11.60.07 Compression Couplings

Only compression fittings will be allowed on copper service pipe. All compression couplings shall be manufactured in accordance with AWWA C800 current standard, Underground Service Line Valves and Fittings, and shall be constructed of brass in accordance with ASTM-B62.

Compression couplings shall be the following type or CITY approved equal:

Ford: C44-G Series (Grip Joint Connection)
 McDonald: 74758-22
 Mueller: H-15403

Upsizing of service lines after the meter shall be in accordance with the detail drawing of this chapter. Compression couplings for upsizing shall be the following type or CITY approved equal:

	1½" to 2"	2" to 3"
McDonald	n/a	n/a
Ford	C44-67-G-NL	n/a
Mueller	H-15403	n/a

11.61.00 ENCASEMENT

11.61.01 Concrete

All concrete shall be a minimum of Class D and shall conform with Chapter 7 of these STANDARDS AND SPECIFICATIONS. All concrete encasements shall be a minimum of 6 inches thick from outside of pipe to outside of encasement. Reinforcement for pipe encasements shall include #4 "hoop" reinforcement steel on 12" centers transverse and longitudinal #4 reinforcement placement shall conform with the Standard Details in the Appendix of these STANDARDS AND SPECIFICATIONS. Material properties for reinforcing steel shall conform with these STANDARDS AND SPECIFICATIONS.

11.61.02 Polyethylene Encasement

Polyethylene encasement material shall be a minimum of 8 mils thick and shall be a high density, cross-laminated polyethylene film. All polyethylene encasement material shall be manufactured in accordance with ANSI/AWWA Standard C-105/A21.5-05, Polyethylene Encasement for Ductile Iron Pressure Pipe and Fittings. The raw materials used to manufacture polyethylene film shall be Type I, Class A, Grade E-1 in accordance with ASTM Standard Designations D-1250. Polyethylene encasement material shall be purple colored.

11.61.03 Extruded Polystyrene Insulating Foam

"Extruded Polystyrene Insulating Foam" or "Rigid, Cellular Polystyrene Thermal Insulation" also referred to as "XPS" shall be manufactured in accordance with ASTM C 578-08b. Bonding sheets of "XPS" together shall be accomplished by using "3M 78 Polystyrene Foam Insulation Spray Adhesive" or CITY approved equal.

11.62.00 METERS

11.62.01 General

Contact the CITY Water Meter Shop (extension 2549) for proper meter for application. Approval of the meter by size, type, and brand shall be obtained from the CITY Meter Shop prior to purchasing the meter. All meters shall be purchased by the CONTRACTOR and delivered to the CITY Meter Shop to be pre-tested prior to installing the meter in the meter setting in accordance with Section 11.39.00 of these STANDARDS AND SPECIFICATIONS.

11.62.02 Magnetic Drive Positive Displacement-Type Reclaimed Water Meters

Contact the CITY Water Meter Shop (303-658-2549) for proper meter for application.

11.62.03 Turbine Meters

Contact the CITY Water Meter Shop (303-658-2549) for proper meter for application.

11.62.04 Mastered Meters

No mastered meters on the reclaimed water system shall be connected to fire hydrants or fire protection lines.

11.62.05 Meter Bypass Line

No bypass lines are allowed on reclaimed meters, pits, or vaults.

11.62.06 Meter Check Valves

For 1-1/2" and 2" meter installations, single check valves shall be installed inline with the service pipe and downstream of the meter setter in accordance with the standard details of this Chapter. Single check valves shall be manufactured in accordance with AWWA C800 current standard, Underground Service Line Valves and Fittings, and castings shall be constructed of brass in accordance with ASTM-B62.

Single check valves for 1-1/2" and 2" meter installations shall be the following type or equal as approved in writing by the CITY ENGINEER:

Ford HS11-666 (1-1/2"); HS11-777 (2")

For 3" and larger meter installations, swing check valves shall be installed downstream and adjacent to the meter as well as on the bypass. Swing-check valves shall be manufactured in accordance with AWWA Standard C-508 current standard, Swing-Check Valves for Waterworks Service (2 in through 24 in) and shall have interior epoxy coating in accordance with AWWA Standard

C-550 current standard, Protective Interior Coatings for Valves and Hydrants. Swing check valves shall have an outside lever and weight and shall have metal seats. Swing check valves shall be iron body bronze mounted with flanged ends in accordance with ANSI B16.1.

Swing check valves for 3" and larger meter installations shall be the following type:

American Flow Control, Series 52-SC and 600
 AVK, 41 Series
 Mueller, A-2600-6-01
 Kennedy, Style 1106

11.62.07 Meter Valves

Meter valves for 1 1/2" through 2" services shall be manufactured in conjunction with the setter. Valve shall be an angle lock wing type ball valve and shall be on the inlet and outlet sides for 1-1/2" and 2" setters.

For valves 4" and larger, gate valves shall be used and shall conform to Section 3.54.02 of these STANDARDS AND SPECIFICATIONS.

11.62.08 Meter Yokes (Setters)

All meter setters shall be manufactured in accordance with AWWA C800 current standard, underground Service Line Valves and Fittings, and all castings shall be constructed of brass in accordance with ASTM-B62. Meter setters shall be designed in accordance with the detail drawings in the appendix of this chapter.

The following meter setters: shall be the following type:

	¾"	1"	1½"	2"
McDonald	732-3-09WX2233	732-4-WX2244	720B618WWFF665	720B718WWFF775
Ford	VB83-9W-44-33-G	VB84-10W-44-44-G	VBB76-18B-11-66-G	VBB77-18B-11-77-G
Mueller	B-2474N	B-2474N	B-2474N	B-2474N

- * 9" setter height
- ** 10" setter height.
- *** 12" setter height. Requires bypass piping.

Bypass orientation will not be allowed on a meter setter solely dedicated for irrigation use.

For installation of a smaller meter on an existing setter, size changes shall be accomplished by providing a full sized meter vault and setter for the line size installed and using industry standard adapters to install a reduced size meter

in the full size line. Adapters: shall be the following type or CITY approved equal:

1 ½" meter on 2" line	- 1 pair Ford A67 adapters
1" meter on 2" line	- 1 pair Ford A47 adapters
1" meter on 1 ½" line	- 1 pair Ford A46 adapters
5/8" X ¾" meter on 1" line	- 1 pair Ford A24 adapters
Other sizes	- Contact Utilities/Meter Shop

11.62.09 Valve and Meter Supports

Meter supports shall be fabricated of concrete and valve supports shall be fabricated of steel in conformance with detail W13 of these STANDARDS AND SPECIFICATIONS.

11.62.10 Meter Pits (¾" and 1" service lines)

No new ¾" or 1" service lines are allowed on the reclaimed water system. Customers that have an existing ¾" or 1" service line that requires repair or modification shall contact the CITY Water Meter Shop (303-658-2549).

11.63.00 PRESSURE-REDUCING VALVE

All pressure-reducing valves shall be approved by CITY ENGINEER. The valve shall be designed to reduce a high upstream pressure to a constant downstream pressure by way of a pilot control system. The pilot system shall control the main valve which shall be single-seated, hydraulically-operated, diaphragm, globe-valve type. The typical valve seats shall be bronze (Note that the manufacturer recommends stainless steel seats when subjected to sustained high velocities through the valve). An indicator rod or flow tube shall be furnished as an integral part of the valve to show the position of the valve.

11.64.00 COMBINATION AIR VALVES

Air release valves shall be in conformance with AWWA C512 current standard, Air Release, Air/Vacuum and Combination Air Valves.

Single body combination air valves shall be the following type or PWU approved equal:

Note that inflow preventers shall be required on all vault installations:

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Combination air valves 2" and smaller shall have threaded NPT type inlets and outlets. For 3" and larger combination air valves, inlets shall be flanged.

Inflow preventers shall be the following type or CITY approved equal for combination air valves installed in vaults that could potentially flood with groundwater:

Val-Matic, Flood Safe

Inflow preventers shall be the following type or CITY approved equal for combination air valve installations that are not prone to groundwater flooding:

Wager Company, Model 2100

11.65.00 RESTRAINING SYSTEMS

11.65.01 Harness Rods

Harness rods and nuts shall be SAE type 304 stainless steel

11.65.02 Joint Restraint Devices

Joint restraint devices shall be manufactured of ductile iron conforming to ASTM A 536. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to AWWA C111/A21.11-07, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings, and ANSI/AWWA C153/A21.53-06, Ductile Iron Compact Fittings. Twist-off nuts, sized the same as the tee-head bolts, shall be used to insure that the proper torque is applied to the bolts. In no case shall the twist-off bolts be torqued beyond the manufacturers' recommendations.

Mechanical joint restraint device shall have a working pressure of at least 350 psi for pipe sizes 4-16 inch and 250 psi for pipe sizes 18-48 inches, with a minimum safety factor of 2:1. Mechanical joint restraint devices shall be the following type:

EBA Iron, Mega-lug, Series 1100 (DIP), Series 2000 (PVC)
Star, Series 3000, 3000S and 3000OS (DIP), Series 4000 (PVC)
Uniflange, Series 1400

Push on joint bell restraint harnesses shall have working pressures for PVC pipe of at least 200 psi for sizes 12 inches and smaller, 235 psi for pipe sizes 14 to 16 inches and working pressures for ductile iron pipe of at least 350 psi for pipe sizes up to 16 inches. Bell restraint harnesses shall be the following type: (bell restraint harnesses are not recommended for pipe sizes above 16 inches):

EBA Iron, Mega-lug, Series 1700 (DIP), Series 1500, 1600 and 2800 (PVC)
Star Pipe Products, Series 3100P (for DIP only)
Smith-Blair, Series 165 (for PVC only)

11.66.00 CONCRETE REINFORCEMENT

All deformed reinforcing bars shall conform to ASTM Standards A-615, Grade 40 or 60, or ASTM Standard A-671, Grade 40 or 60. All welded wire steel fabric shall conform to ASTM Standard A-185.

11.67.00 BACKFLOW PREVENTION ASSEMBLIES

Backflow prevention assemblies shall conform to the requirements of AWWA C511 current standard, Reduced Pressure Principle Backflow Prevention Assembly. Backflow assemblies shall also meet the application requirements in Chapter 3 of these STANDARDS AND SPECIFICATIONS and Section 8-7-27 of the CITY CODE.

11.68.00 REPAIR CLAMPS

Repair clamps shall be entirely 18-8 Type 304 stainless steel including bands, lugs, nuts, and bolts. Gaskets shall be gridded virgin GPR compounded for water service and meeting the requirements of ASTM D 2000-90M 4AA607. Repair clamps shall be single or double panel as required to fit the pipe and shall have a minimum working pressure rating of 150 psi. Repair clamp length shall be greater than or equal to the host pipe diameter.

Repair clamps approved by the CITY shall be one of the following types:

- PowerSeal, Model 3121AS or 3122AS
- Ford, Style FS1 or FS2
- Smith-Blair, Models 261 and 262
- Romac, Style SS1 or SS2