

FORT COLLINS UTILITIES

Water and Wastewater Design Criteria Manual

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Fort Collins Utilities Water and Wastewater Design Criteria Manual

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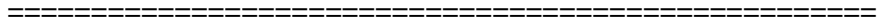
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FORT COLLINS UTILITIES WATER AND WASTEWATER DESIGN CRITERIA MANUAL

SECTION 1 – GENERAL PROVISIONS

1.01 INTENT

- A. These Design Criteria, hereinafter referred to as the “Criteria”, shall be known as the Fort Collins Utilities (FCU) Water and Wastewater Design Criteria and shall be the governing Criteria for the public water distribution and wastewater collection improvements that are designed and installed in conjunction with the City’s Development Review Process and are within areas wherein FCU owns and operates such systems.
- B. These Criteria, with all future amendments, establish minimum design standards for providing and maintaining the public water distribution and wastewater collection systems. Whenever the requirements of these Criteria are found to be inconsistent with any other adopted standards, regulations or codes, the more restrictive criteria, standards, regulations or codes shall control.
- C. The Design Engineer is responsible for compliance with these Criteria as well as other applicable design and construction standards in the preparation of engineering and construction documents for review and acceptance by FCU. The provisions of these Criteria are minimum requirements that do not preclude the use of more restrictive standards by the Design Engineer.
- D. The design of all public improvements shall be by or under the direction of a Professional Engineer duly registered and licensed by the State of Colorado.
- E. Adherence to these Criteria does not remove the Developer’s responsibility to investigate and obtain any other regulatory permits or approvals from local, regional, state or federal agencies that may be required for a particular project.

1.02 REVISIONS AND UPDATED CRITERIA

The Criteria may be amended as new technology is developed or as a need for revision is demonstrated and proven through experience and use. FCU will maintain these Criteria and any amendments thereto and will post these Criteria and amendments on the City’s website. FCU does not keep a database of holders of these Criteria. It shall be the responsibility of each holder to verify the most current Criteria are being used for any Development Project.

1.03 OTHER RELATED STANDARDS

- A. Chapter 26 of City Code and these Criteria set forth the minimum standards for designing public improvements in the FCU water and wastewater service areas.
- B. All public water and sanitary sewer improvements shall comply with the FCU Water Distribution System and Wastewater Collection System Master Plans.
- C. All public stormwater improvements shall comply with the Fort Collins Stormwater Criteria Manual.

- D. Materials and installation of the water, wastewater and stormwater improvements shall comply with the City of Fort Collins - Water, Wastewater, Stormwater Development Construction Standards.
- E. The Planning Department administers the Fort Collins Land Use Code which defines the various processes required for development projects within the City.
- F. Engineering Development Review administers the Larimer County Urban Area Street Standards (LCUASS) which set forth standards for certain public improvements within City R.O.W. and public easements.

1.04 DEFINITIONS

AASHTO – American Association of State Highway and Transportation Officials.

AWWA – American Water Works Association.

City - City of Fort Collins.

City Code - The latest officially adopted City Code of Fort Collins, Colorado

Contractor - A person, partnership or corporation duly licensed and bonded in the City of Fort Collins in accordance with the requirements of the City Code.

CP – Cathodic Protection or Cathodically Protected.

Design Engineer - The partnership, corporation or individual who is registered as a Professional Engineer according to Colorado Statutes, who is hired by the Developer/Owner to conduct engineering design services and who may be empowered by the Developer/Owner to act as his/her agent for the project.

Developer or Developer/Owner – This includes the person or persons, public or private, legally responsible for construction of improvements within a specific development.

DI / DIP – Ductile iron / ductile iron pipe.

Distribution Main – The portion of the water or waste water system that conveys water or wastewater to or from the transmission mains for use at a neighborhood scale.

Easement – A right granted by the property owner permitting a designated part or interest of the property to be used by others for specific use or purpose.

FCU – Fort Collins Water, Wastewater and Stormwater Utilities.

FDP (Final Development Plan) – Final plans submitted after the public hearing as outlined in the City’s Development Review Process.

GPM – Gallons per minute.

HDPE – High density polyethylene.

Inspector - The authorized representative of the City assigned to make detailed inspections for contract performances, standards and contract compliance.

LCUASS – Larimer County Urban Area Street Standards.

May - A permissive condition. No requirement for design or application is intended.

MJ – Mechanical joint.

Non-Potable – Water that is not treated to drinking water standards and is not suitable or intended for human consumption.

Owner – Any person having title or rights of ownership in the surface of real property or leasehold interest therein.

PDP - Project Development Plan

Professional Engineer – A registered engineer licensed by the State of Colorado with expertise and qualifications in the areas covering the scope of work.

PSI – Pounds per square inch of pressure.

PVC – Polyvinyl chloride.

Record Drawings - Detailed drawings which have been prepared by a Professional Engineer registered and licensed by the State of Colorado, upon completion and prior to final acceptance, and show actual construction and contain field dimensions, elevations, details, changes made to the Construction Drawings by modification, details which were not included on the Construction Drawings, and horizontal and vertical locations of underground utilities which have been impacted by the utility installation. Record Drawings are usually Construction Drawings which have been modified to contain the information listed above.

R.O.W. or Right-of-Way - A general term denoting land, property, or interest therein, usually in a strip acquired for or devoted to a street or utility.

Sewer – In these Criteria, sewer shall refer to sanitary sewer.

Shall - A mandatory condition. Where certain requirements in the design or application are described with the “shall” stipulation, it is mandatory that these requirements be met.

Should - An advisory condition. Where the word “should” is used, it is considered to be advisable usage, recommended be not mandatory. Deviations may be allowed when reasons are given which show that the intent of the standard is met.

Street - A general term denoting a public way for purposes of vehicular travel, including the entire area within the R.O.W. (including alleyways).

Storm Drain - Any conduit and appurtenance intended for the reception and transfer of stormwater.

Storm Drainage Design Criteria - The current City of Fort Collins Stormwater Criteria Manual.

Transmission Main – Typically, a main larger than 16 inches in diameter used to convey water to the distribution system or wastewater from the distribution system to the wastewater treatment plant.

Utility - Utilities Executive Director or his/her authorized representative.

Utility Plans - Details and working drawings including plan, profile and detail sheets of proposed improvements for development projects approved by the Engineer/Utility.

1.05 VARIANCES

- A. Any design that does not conform to these Criteria must be approved by the Utilities Executive Director. Variances from these Criteria will be considered administratively on a case-by-case basis following a written request for a variance prepared by a Professional Engineer and submitted to the FCU Water Utilities Senior Development Review Engineer. To assist with plan preparation, designers may submit variance requests, along with documentation to support the variance, for informal advisory consideration prior to formal submittal of utility plans. Such advisory consideration shall not be binding on FCU but may help guide the designer in the preparation of plans.
- B. Variances requested as part of the formal submittal of utility plans shall be shown on the plans and shall also be specifically substantiated and justified in a letter addressed to Utilities Executive Director. A summary of all approved variances shall be listed in the general notes on the approved plans.
- C. The variance request shall include, at minimum, the following:
1. Identifying Issue: Identification of the standard to be varied and the reason that the standard is not feasible or not in the public interest.
 2. Proposed Alternate Design: Identification of the proposed alternate design or construction criteria.
 3. Comparison to FCU Criteria: A thorough description of the variance request including the impact on capital and maintenance requirements, costs and how the proposed design compares to the Criteria.
 1. Justification: The Professional Engineer must determine and state that the variance will not be detrimental to public health, safety and welfare and will not reduce the design life of the improvement nor cause FCU additional maintenance costs. The proposed plan must advance the public purpose of the Criteria sought to be varied equally or better than would compliance with these Criteria.
- D. Approval or Denial of Variance: Based upon review of the utility plans and additional information submitted and an analysis of the process set forth in this Subsection 1.05 C., the Utilities Executive Director may approve or deny the variance request. If the request is approved, the plans will continue to be reviewed and approved within the typical review

process. If the request is denied, the Developer shall subsequently submit revised plans in compliance with these Criteria. A written response outlining the basis for all approvals or denials of variance requests will be provided by the FCU Water Utilities Senior Development Review Engineer.

1.06 ENFORCEMENT AND INSPECTION

- A. These Criteria are enforceable by the City at any point in the City’s Development Review Process, including installation and inspection of the public improvements.
- B. Inspection services during construction are provided by the City’s Engineering Department.

1.07 PUBLIC WATER AND WASTEWATER EXTENSION AND OVERSIZING

- A. As indicated in City Code Section 26-369 (d), Developer shall install water mains and sanitary sewers to the farthest point or points of the property to be served when in the opinion of the Utilities Executive Director such extension is desirable to provide for future extensions of the water and wastewater systems.
- B. If FCU requires a Developer to install water mains and sanitary sewers for a subdivision or development of a size or capacity greater than that necessary to serve the new development, if greater than the minimum size required as outlined in this Manual, the City shall pay the extra expense caused by the oversizing as outlined in City Code Section 26-371.

1.08 EASEMENTS

- A. All City-owned public utilities including water and wastewater facilities shall be located in public R.O.W. or public utility easement.
- B. Minimum easement widths are listed in the table below. In certain limited situations when a sanitary sewer is less than 10 feet deep, the sanitary sewer easement width may be reduced to 20 feet if approved by FCU. At the discretion of FCU, wider easements may be required where the depth of a utility or the number of utilities occupying the easement necessitates additional width to satisfy standards for utility separations, trenching excavations, maintenance access and safety.

Minimum Easement Requirements for Water Mains and Sanitary Sewers

Utility	Minimum Easement Width
Water main	20 feet (centered on the main)
Sanitary Sewer	30 feet (centered on the main)
Combined Water and Sewer	35 feet

SECTION 2 – UTILITY PLAN AND RECORD DRAWING REQUIREMENTS

2.01 GENERAL

- A. Utility plans for public water and wastewater improvements shall be prepared and submitted in accordance with these Criteria.
- B. To assist with preparation of the utility plans, Appendix A includes a checklist outlining the information required. Refer to the checklist for additional requirements. This checklist is required to be completely filled out by the Engineer who prepared the Utility Plan and submitted with the Utility Plan submittal.
- C. As a minimum, the utility plan set shall include:
 - 1. Cover sheet
 - 2. General and construction notes
 - 3. Overall utility plan
 - 4. Plan and profile sheets as required
 - 5. Applicable standard construction details

2.02 UTILITY PLANS

- A. Refer to Utility Plan Checklist in Appendix A for Project Development Plan (PDP) and Final Plan (FP) submittal items.
- B. Scale on the plan views shall be 1 inch = 20 feet, 30 feet, 40 feet or 50 feet. These sheets may also include details and designs for lowerings, crossings or special items to clarify the intent of the information shown on that particular sheet.
- C. Plan and profile sheets are required for all water mains 12-inch and larger and for all sanitary sewer mains. On minor projects, the water main profile may be omitted if approved by the FCU Water Utilities Senior Development Review Engineer. A specific profile view or design detail shall be included for each lowering or crossing as noted in Section 3.06 G. of these Criteria.
- D. All projects must use benchmarks documented in the current City of Fort Collins Vertical Control Network. Assumed vertical datums or adjustment equations are not allowed.
- E. All construction or sequence phasing shall be clearly noted such that each phase is depicted in a “stand alone” manner. In some cases, water mains or sanitary sewers may be required to extend beyond a particular phase to provide acceptable redundancy for water or discharge points for sewer. In these cases, the plan sheets shall clearly show the applicable phase lines, design, details, R.O.W., easements, etc. to accommodate such extensions beyond a particular phase.

- F. On plan and profile drawings, longitudinal stationing based upon centerline of main shall be included for all water and sanitary sewer mains and related appurtenances (e.g. service connections, valves, fittings, fire hydrants, manholes, vaults, blow-offs, air release/vacuum valves, etc.). Stationing for water mains shall generally read in ascending order in the direction of the north arrow or from left to right and for sanitary sewers shall be from downstream to upstream.
- G. Horizontal locations for all proposed and existing water mains and sanitary sewers shall be dimensioned from the centerline of the R.O.W. or easement. In some cases, additional dimensioning may be required for purposes of clarity and future reference.
- H. Existing structures, wet and dry utilities and ground surfaces shall be included on all plan views (shown as phantom lines and shapes). These existing items shall be dimensioned in a manner that clearly shows the relationship to the proposed water mains and sanitary sewers. This shall include but is not limited to:
 - 1. All water, wastewater, storm drainage, electric, cable television, communications lines and any related appurtenances.
 - 2. Drainage and irrigation ditches or swales
 - 3. Fence lines and gates
 - 4. Bridges and culverts
 - 5. Curb lines and other roadway features
 - 6. Existing landscape features
 - 7. Other items required by FCU

2.03 WATER SYSTEM PLANS

- A. The following shall be clearly shown and labeled:
 - 1. Pipe material, diameter, lengths between fittings, valves, fire hydrants and appurtenances, etc.
 - 2. All fittings and water main appurtenances
 - 3. Services with size and curb stop locations
 - 4. Location and size of all water meter pits and vaults
 - 5. Casings including material, diameter, thickness and length
 - 6. All lowerings and vertical sweeps
 - 7. Match lines with and sheet numbers

8. Phase lines
 9. Hatching or labeling to indicate beginning and end of all portions of the water main being restrained with restrained lengths clearly shown and labeled
- B. Water main profiles shall include the following:
1. Existing ground profile shown as dashed line
 2. Proposed ground profile shown as solid line
 3. All items required in 2.03 A. of these Criteria with longitudinal stationing and design elevations for each item noted
 4. Depths of water main relative to proposed ground profile
 5. All utility crossings (existing and proposed) with longitudinal stationing and elevations noted
 5. Groundwater barriers based upon groundwater levels

2.04 WASTEWATER SYSTEM PLANS

- A. The following items shall be clearly shown and labeled:
1. Size, type and class of all portions of sanitary sewer with lengths between manholes
 2. Manholes with diameter, longitudinal stationing and any special features
 3. Service lines with diameter and longitudinal stationing
 4. Casings with material, diameter, thickness or class of pipe, longitudinal stationing of beginning and ending points
 5. Sewer joint encasements and longitudinal stationing
 6. Grease interceptors
 7. Sand and oil interceptors
 8. Match lines with longitudinal stationing and sheet numbers
 9. Phase lines with longitudinal stationing
- B. Profiles are required for all sanitary sewers and shall include the following:
1. Existing ground profile shown as dashed line
 2. Proposed ground profile shown as solid line

3. All items required in 2.04 A. of these criteria with the design elevations of each item noted
4. All manhole rim and inflow/outflow invert elevations
5. All utility crossings (existing and proposed) with elevations noted
6. Pipe joint encasements with type of encasement and longitudinal stationing noted
7. Groundwater barriers based upon groundwater levels

2.05 UTILITY STANDARD DETAILS

- A. A copy of each applicable Standard Construction Detail Drawing shall be included on the Utility Plan detail sheet. All Standard Construction Details shall be shown as originally prepared by FCU and shall not be altered without first obtaining written approval from the FCU Water Utilities Senior Development Review Engineer.
 1. If alteration is approved by FCU, the Standard Construction Drawing must clearly show “Revised – *Project Name*” in bold letters near the title block of the drawing.
- B. All other non-standard details (e.g. lowerings, special construction items, crossings, etc.) shall be included on the appropriate plan or plan and profile sheet.
- C. Lists of the Standard Construction Detail Drawings are included in the City of Fort Collins Water, Wastewater, Stormwater Development Construction Standards.

2.06 FINAL UTILITY PLANS

- A. An electronic version, in a format acceptable to the City, of the final utility plans shall be provided to FCU at the time that the final Mylar plans are submitted. The electronic plans shall include all approval signatures and Design Engineer’s seal and signature.

2.07 RECORD DRAWINGS

- A. Utility plans shall be updated per the currently approved Water, Wastewater, Stormwater Development Construction Standards with all design and construction changes that occurred after plan approval.
- B. Record drawings shall be prepared with a cooperative effort of a Professional Engineer and the Contractor as follows:
 1. Document dimensions, grades/slopes, lengths, elevations and details that in the opinion of FCU or the Engineering Department Inspector were substantially different from the approved utility plans.
 2. Include horizontal and vertical locations of underground utilities not shown on the original approved utility plans.

3. Drawings are prepared in a manner that shows changes legibly and denotes the change by clouding or similar means to clarify the change or revision that was made.
 4. Drawings are clearly labeled RECORD DRAWING in bold font and be signed and sealed by the Professional Engineer.
 5. Submit one copy as blue or black-line sheets to the Engineering Department Inspector for review. Once approved by the Engineering Department Inspector, submit six (6) sets of paper copies and one (1) set of reproducible double matte mylars all in a 24-inch x 36-inch format.
- C. Following approval of the Record Drawings, the Professional Engineer completing the Record Drawings shall provide the following to FCU in AutoCAD version 2007 or newer: Horizontal coordinates, elevations, utility linework and other pertinent information for the purposes of FCU revising and maintaining the utility mapping system.

SECTION 3 – WATER DISTRIBUTION DESIGN CRITERIA

3.01 GENERAL

These Criteria typically apply to potable water distribution mains 16-inch diameter and smaller. Larger mains are considered transmission mains. If a development project includes any construction of or modification to a transmission main, contact the FCU Water Utilities Senior Development Review Engineer and the FCU Water Engineering Capital Projects Division for design and construction requirements.

3.02 WATER/WASTEWATER DEMAND ANALYSIS REPORT

In conjunction with the City's Development Review Process, FCU **may** require that the Design Engineer submit a Water/Wastewater Demand Analysis Report at the time of PDP. If the analysis report is required, a meeting with FCU Water Utilities Senior Development Review Engineer must be held to determine the outline and scope of the report.

3.03 WATER SYSTEM MODELING

If, during the development review process, FCU determines that a dynamic analysis is needed for proper sizing of water mains, FCU will assist with the necessary modeling to evaluate the proposed project and associated demands with detailed information provided by the Design Engineer.

3.04 FCU WATER SERVICE AREA

- A. FCU provides water service to a portion of the area inside City limits and other areas to the northwest of the City including parts of the community of Laporte, Colorado. (See Water Utility Service Areas Map in Appendix B for a map current as of the date of the adoption of this manual.)
- B. Other portions of Fort Collins receive water service from the following water districts:

East Larimer County Water District (ELCO)
232 S Link Lane
Fort Collins, CO 80524
Telephone: 970-493-2044

Fort Collins-Loveland Water District
5150 Snead Drive
Fort Collins, CO 80525
Telephone: 970-226-3104

Northern Colorado Water Association
4389 E Co Rd 70
Wellington, CO 80549
Telephone: 970-568-3975

Sunset Water District
Telephone: 970-491-3237

West Fort Collins Water District
2711 N Overland Trail
Laporte, CO 80535
Telephone: 970-484-4881

- C. When designing water main extensions, it is important to avoid designing/constructing mains which would interconnect with these various utilities.

3.05 PRESSURE ZONES

Within the FCU water service area, there are two pressure zones. The Foothills Pressure Zone is located in the western part of the city and extends northwest to the Laporte, Colorado area. The Main Pressure Zone covers the remainder of the Fort Collins Utility's water service area. (See Water Pressure Zones Map in Appendix B) It is important to avoid interconnecting water mains serving the two distinctly separate pressure zones.

3.06 WATER DISTRIBUTION SYSTEM DESIGN AND LAYOUT

A. General

1. Each development shall have redundant sources of water supply to provide a combination of adequate fire flow, uninterrupted customer service and acceptable water quality. Redundancy is typically achieved by making at least two separate and distinct connections to the existing Public Water System. Based upon the magnitude and water demands of a proposed development project, FCU may require a greater number of connections.
2. All distribution mains shall be looped into the existing and proposed distribution system to ensure at least two feed sources and to maintain system reliability except where allowed as follows. Permanent dead end mains are discouraged and should be avoided when practical. The most common exceptions are cul-de-sacs. If a dead end main is approved by FCU (temporary or permanent), there must be a fire hydrant at the end for flushing. Where allowed, the length of permanent dead ends shall be limited to a maximum of 660 feet.
3. Additionally, it is critically important within each development that the site layout be designed in a manner that accommodates acceptable access for maintenance and replacement of the system by FCU, including adequately designed all-weather access for mains installed outside of a public roadway. The Design Engineer shall make adequate provisions for utility separation requirements and easements outlined in these Criteria.

B. Hydraulic Parameters

1. Pressure – The distribution system shall be designed to provide a minimum pressure of 40 psi under maximum hour demand flow and a residual pressure of 20 psi at ground surface elevation under maximum demand condition plus fire flow required by Poudre Fire Authority.

2. Velocity – All water mains (with the exception of fire hydrant laterals) shall be designed for a maximum velocity of 10 feet per second at peak hour demand plus design fire flow.

C. Water Main Size

1. Allowable Distribution Main Sizes: 6, 8, 12 and 16-inch diameters. Minimum size is typically 8-inch with the exception of short cul-de-sacs and fire hydrant laterals.
2. Section Lines and Quarter Section Lines: Minimum size is 12-inch unless a larger main is included in the Distribution System Master Plan.
3. All public water main sizes shall comply with the FCU Water Distribution System Master Plans.
4. Plan and profile drawings are required in the utility plans for all water mains 12-inch and larger. On minor projects, the water main profile may be omitted if approved by the FCU Water Utilities Senior Development Review Engineer.

D. Pipe Material

1. Water mains up to and including 12-inch in diameter shall be cement-mortar lined ductile iron pipe (DIP) in accordance with AWWA C151 or polyvinyl chloride (PVC) pipe in accordance with AWWA C900.
2. Water mains 16-inch and larger shall be cement-mortar lined ductile iron pipe (DIP) in accordance with AWWA C151 or polyvinyl chloride (PVC) pipe in accordance with AWWA C905.
3. All ductile iron pipe (DIP) shall be installed with polywrap in accordance with AWWA C105.
4. All polyvinyl chloride (PVC) pipe shall be installed with tracer wire.

E. Alignment

1. Within platted streets, sanitary sewers are typically on the centerline of the street and water mains are a minimum of 10 feet from the sewer. In addition, the water main shall be a minimum of 5 feet from the face of curb.
2. Straight Alignment - In general, water mains shall be laid with straight alignments with manufactured, ductile iron, mechanical joint bends.
3. Curved Alignment – If allowed, water mains installed in curved portions of street R.O.W.s or easements may be designed utilizing pipe joint deflection.
 - a. DIP – Pipe joint deflection for DIP shall not exceed 80% of the manufacturer's recommended allowable joint deflection.
 - b. PVC – Pipe joint deflection for PVC pipe shall not exceed 1 degree per section of pipe. Bending of the pipe is not allowed.

F. Water Main Depth

Normal depth of cover for all distribution mains is a minimum 4.5 feet to a maximum of 5.5 feet measured from finished grade to top of water main. Depths of cover outside of this range require approval from the FCU Senior Water Development Review Engineer with input from Water Field Operations staff. If less than 4.5 feet of cover is allowed, the Design Engineer must design the thickness and extent of the insulation to be provided to mitigate the shallower depth of cover and include a detail showing the placement and dimensions of the insulation and the specifications for the insulation which is suitable for underground applications.

G. Lowerings

1. In cases where the normal water main depth results in a conflict with other utilities, the water main shall be lowered to mitigate the conflict. Combination air release / vacuum valves shall be required at high points that are created by the lowering of 12-inch and larger water mains and may be required on smaller mains at the discretion of FCU.
2. When the lowering is crossing below another pipeline 18-inch or larger, a bank of multiple pipelines or a box culvert, the water main shall be installed in a casing. Refer to Section 3.06 P. of these Criteria for details regarding the casing materials.
 - a. Casing shall extend a minimum of 10 feet beyond each side of the pipeline or other utility above.
 - b. 18" of vertical separation is required between the top of the casing pipe and the bottom of the other utility.
 - c. Water main shall be restrained through the casing utilizing restrained joint pipe or approved joint restraint devices. The use of tie-rods is not allowed.
 - d. Isolation valves are required at both ends of these lowerings 40 feet back from the end of the casing and shall be restrained in accordance with the Standard Detail for Restrained Pipe Lengths for Dead Ends to prevent the valve from "blowing off" when the piping in the lowering area is disassembled for repair or replacement.
 - e. No services or connections are allowed between the isolation valves.
3. All lowerings are subject to the clearance standards contained in these Criteria.
4. Lowerings may be designed utilizing manufactured bends or pipe joint deflections.
 - a. Manufactured bends shall be mechanical joint (MJ) fittings restrained by approved mechanical joint restraints with restrained lengths in accordance with the Standard Detail for Restrained Lengths w/ Approved Joint Restraints for Lowerings.
 - b. Pipe joint deflection for DIP shall not exceed eighty percent (80%) of the pipe manufacturer's recommendation for maximum joint deflection.
 - c. Pipe joint deflection for PVC pipe shall not exceed one degree per section of pipe. Bending of the pipe is not allowed.

5. All lowerings shall be labeled on the utility plans
6. When fittings are used, a detail for each lowering is required on the utility plans showing size and elevation of both utilities, fittings, valves, distance between fittings, casing diameter and thickness (if applicable) and other pertinent information.
7. When pipe joint deflection is used, indicate on the utility plans the water main station where the deflection starts and ends.
8. Valves may be required at both ends of lowerings other than those noted in Section 3.06 G. 2. C. and, if required, shall be restrained or located sufficiently back from lowering to prevent the valve from “blowing off” when the piping in the lowering area is disassembled for repair or replacement.
9. No water services, fire hydrants or fire lines shall be connected to the water main within the lowering area.

H. Connections to Existing Distribution System

1. FCU seeks to achieve a reliable and redundant water supply for its customers and to minimize interruptions of service. A service interruption for the purpose of installing a new water main connection to the existing distribution system must be closely coordinated with and approved by FCU. Each request for a service interruption will be evaluated from the standpoint of the impacts on customer water needs, water quality, fire protection requirements and other pertinent factors that may arise for a particular development proposal.
2. Connections to the existing system may be made by installing a wet tap or by cutting in a tee. The preferred approach is to install a wet tap. Each connection will be reviewed by FCU to determine which method will be required.
3. At the discretion of FCU, a valve may be required at each new connection point to allow for isolation from the existing system.

I. Valves

1. Gate valves shall be used on all mains up to and including 12-inch.
2. Butterfly valves shall be used on all mains 16-inch and larger and shall be installed in a valve vault (See Butterfly Valve Vault Standard Detail).
3. Valves are required at all crosses and tees. The minimum number of valves at these locations is generally the number of connections minus one. For example, a cross fitting has four connections; therefore, the design should include a minimum of three valves.
4. No more than 600 feet of water main shall be located between isolation valves. On transmission water mains with no service connections, valve placement will be evaluated on a case by case basis.

5. No more than one fire hydrant shall be located between isolation valves.
6. Valves are required on both sides of stream crossings, railroad crossings and bored crossings. Valves shall be located back from the crossing or restrained in such a manner as to prevent the valve from “blowing off” when the pipe is disassembled between the valves for maintenance or replacement. No water services shall be connected to the water main between these valves.
7. Valves may be required on both sides of water main lowerings (See Section 3.06 G. of these Criteria).
8. FCU may require installation of additional valves not shown on the plans when determined necessary in the field with coordination of the Owner/Developer and/or Design Engineer.
9. Valves shall be located to provide maximum accessibility and shall not be placed in areas subject to routine parking and storage operations.
10. Combination air release / vacuum valves are required at high points on all water mains 12-inch and larger and at all other locations as required by FCU.

J. Fire Hydrants

1. All fire protection, fire flow and fire hydrant requirements are subject to the approval of the Poudre Fire Authority.
2. Hydrant Spacing and Flow

	Maximum Distance Building to Hydrant (*)	Maximum Distance Between Hydrants (*)	Minimum Flow at 20 psi
Single-Family Residential	400 Feet	800 Feet	1,000 gpm
Multi-Family Residential & Commercial	300 Feet	600 Feet	1,500 gpm

(*) Distance measured on path of vehicle travel

3. Where water mains are extended along streets through areas that will not be developed (open space, parks, etc.), hydrants shall be provided at spacing not to exceed 1,000 feet.
4. Hydrants shall be located at intersections whenever possible. Mid-block hydrants shall be installed at the extension of a property line at a location that avoids conflicts with dry utility service lines.
5. Fire hydrants shall be placed at the end of all cul-de-sacs. The hydrant valve shall be located in the paved street a minimum of 5 feet from the curb and gutter. The hydrant,

gate valve, all pipe joints and fittings from the hydrant to a point a minimum of 100 feet upstream of the valve shall be restrained in accordance with the City of Fort Collins - Water, Wastewater, Stormwater Development Construction Standards.

6. Hydrants laterals must be restrained at connection to main (swivel tee with gate valve or wet tap with gate valve), at hydrant and at all joints between the distribution main and the hydrant with approved joint restraint devices.
7. Fire hydrant assemblies are required on all permanent or temporary dead end water mains. The hydrant lateral shall be at a right angle to the distribution main installed with a swivel tee. (See Fire Hydrant Installation Standard Detail).
8. A 3 foot radius in all directions around the hydrant shall be free of all obstructions.
9. Where hydrants are vulnerable to vehicular damage, hydrant shall be protected by fire hydrant guard posts.
10. All fire hydrants shall have 6 foot depth of bury with fire hydrant flange above finished grade by 0.1 to 0.2 feet.
11. Hydrants shall be located within the public R.O.W. or utility easement.

K. Thrust Restraint

1. The preferred method of thrust restraint shall be accomplished by restraining pipe joints and fittings with approved joint restraint devices on all water main fittings and appurtenances to provide reaction support due to unbalanced thrust forces. The minimum required restrained joint lengths shall be in accordance with the Standard Details in these Criteria and the EBAA Iron - Restraint Length Calculator v7.1.2. The Design Engineer is responsible for determining that the minimum lengths listed in the Standard Details are adequate to provide the necessary thrust restraint for situations encountered on the project.
2. The basis for the restrained joint length calculations is listed on the Standard Details. If the circumstances are different than those listed, the Design Engineer shall submit revised calculations to FCU for approval.
3. Restrained pipe lengths shall be clearly shown and detailed on the utility plans and final Record Drawings.
4. Approved joint restraint devices shall be used on all joints and fittings for fire hydrant installations from the connection at the water main to the connection of the hydrant to the fire hydrant lateral. (See Standard Detail)
5. Approved joint restraint devices shall be used on all pipe joints within a casing pipe.
6. Approved joint restraint devices are listed in the City of Fort Collins - Water, Wastewater, Stormwater Development Construction Standards.

7. With prior approval from FCU, concrete thrust blocks may be used when conditions make it impractical to use restrained joints for thrust restraint or if requested by the Contractor, at the discretion of FCU.
8. When a new connection is installed on the existing FCU distribution system by cutting in a tee or installing a wet tap, a concrete thrust block shall be used for thrust restraint behind the tee or tapping saddle. This applies to connections for fire hydrants, fire lines, distribution mains or large domestic services.

L. Services

1. General

- a. Water services shall be located a minimum of 10 feet from sewer services, sanitary sewers, storm sewers and other non-potable pipelines.
- b. Water services shall not be installed in the same trench with other utilities. The only exception will be a fire line that will serve the same building. In this situation, the domestic water service and the fire line shall be a minimum of 5 feet apart.
- c. All portions of service lines shall be installed with a minimum of 4.5 feet of cover and a maximum of 5.5 feet of cover from final finished grade.
- d. Service taps shall be connected directly to FCU water system distribution mains and shall not be connected to any fire hydrant lateral or fire service line.
- e. Services shall be perpendicular to the main from the location of connection to a point beyond the curb stop (and meter pit where applicable).
- f. Service shall be the same size as the meter from the location of connection at the main to a point 5 feet beyond the meter unless otherwise approved by the FCU Water Utilities Senior Development Review Engineer. At the point 5 feet beyond the meter, the size of the service line may be increased to reduce hydraulic losses.
- g. All services ¾-inch through 2-inch shall have a curb stop located within R.O.W. or utility easement adjacent to the R.O.W.
- h. The shut-off/control valve for all services larger than 2-inch shall be an approved gate valve at the point of connection to the distribution system water main. The valve shall be restrained to the main at the point of connection with a swivel tee, tapping sleeve or other approved joint restraint device.
- i. Connection for a 3-inch service shall be 4-inch tap with a 4-inch valve and a 4-inch by 3-inch reducer located at the point of connection at the water main.
- j. Services from a property shall connect directly to a public water main without crossing another private property. This requirement does not apply to the common, private service lines serving single-family attached dwellings.
- k. Materials:
 - (1) ¾-inch & 1-inch services shall be Type K copper.
 - (2) 1½-inch & 2-inch services shall be Type K copper or HDPE with tracer wire.
 - (3) Services larger than 2-inch shall be DI or PVC with tracer wire.
- l. No service connections are allowed within a water main lowering.
- m. No service connections are allowed within 10 feet of a utility crossing.
- n. Domestic water services and fire lines for a given lot shall be connected the FCU water main within the confines of the property lines extended.

- o. Domestic water services and fire lines that are not used with the development shall be abandoned at the main in accordance with Section 3.11 of these Criteria.

2. Domestic Services

a. General

- (1) Curb stops shall be located within R.O.W. or utility easement approximately 1 foot from the property line or back of easement boundary.
- (2) Mixed use buildings must have separate water services for the residential and commercial portions of the building.
- (3) Sizing of water service lines for multi-family and commercial buildings shall be done by the Design Engineer. When requested, the sizing calculations shall be submitted to FCU for review and approval.

b. Single Family

- (1) Each single family lot shall have a separate ¾-inch water service line connecting directly to a FCU distribution system water main without crossing another property.
- (2) Water service shall be placed near the center of the lot in a location that will not be under a drive, tree or structure.

c. Single Family with Carriage House

- (1) On a single family lot, water service may be extended from the principal residence to a carriage house if approved by FCU, if the water service has adequate capacity for both buildings and if the buildings are on a single platted lot under single ownership, and as otherwise consistent with City Code.

d. Duplex

- (1) Each dwelling unit in a duplex shall have a separate water service extending from an FCU water main.

e. Multi-Family

- (1) Each multi-family building shall have a separate water service connecting directly to a FCU distribution system main without crossing another property; however, FCU may require a multi-family building to have more than one service.

f. Single Family Attached Dwellings

- (1) For single family attached dwellings where each dwelling unit is on a separate platted lot, each unit must have a separate shut-off and meter; however, if approved by FCU, a common, private water service can be extended across property lines to serve up to six units with each unit having a separate shut-off and meter connecting to the common, private water service line. (See City Code Section 26-94)

g. Non-Residential

- (1) Each non-residential building shall have a separate water service connecting directly to a FCU distribution system main without crossing another property; however, FCU may require a non-residential building to have more than one service.

3. Irrigation Services

- a. Separate irrigation services and meters connecting to distribution system mains are allowed subject to fees and charges included in Chapter 26 of City Code.
- b. Each separate irrigation service must connect directly to an FCU distribution system main and must not cross another property to reach the property being irrigated.
- c. An approved backflow device in compliance with all applicable City regulations will be required on all irrigation services.
- d. Sizing of water service lines for irrigation services shall be done by the Design Engineer. When requested, the sizing calculations shall be submitted to FCU for review.
- e. The final capacity of a water service/meter is dependent on the system pressure and water tap size. There is no guarantee of available flow based on meter size.

4. Fire Services

- a. Fire sprinkler lines 2-inch and smaller shall have a curb stop located within R.O.W. or utility easement adjacent to the R.O.W.
- b. Fire sprinkler lines larger than 2-inch shall have an approved gate valve at the point of connection to the FCU distribution system water main.
- c. No domestic water service taps are allowed to connect to a fire line.

M. Meters

1. All domestic and irrigation water services connected to the FCU water distribution system shall be metered.
2. Water meter sizes allowed include ¾, 1, 1½, 2, 3, 4, and 6-inch.
3. Single family residences shall be limited to one ¾-inch meter and service.
4. Meter locations:
 - a. ¾-inch meters may be installed within a building or outside in a water meter pit. (See Standard Detail Drawings for interior and exterior meter settings.)
 - b. Meters 1-inch and larger shall be installed outside in meter pits/vaults.
 - c. Modifications to the meter locations may be approved by the Utilities Executive Director or his/her assigned delegate during the Development Review process.
5. Interior meters shall be located where the water service enters the building and shall not be in crawl spaces. In commercial buildings, interior meters must be installed in a mechanical or fire riser room.
6. Exterior meters (¾-inch through 2-inch) shall be installed within 2 feet of the curb stop.
7. Exterior meters shall be located in landscaped areas. The only exception to this is in commercial areas where there is no landscaped area between the street and the building.

8. Modification, alteration or relocation of metering equipment must be approved by FCU before any such modification, alteration or relocation occurs.
8. The Design Engineer/Developer is responsible for determining the potential loadings on meter pits/vaults and shall provide adequate structural strength for these loadings. FCU may require AASHTO HS-20 loadings at its option.
10. Meter installations must be located to provide protection from freezing and frost damage.

N. Borings

1. Water mains through City of Fort Collins or another agency's R.O.W. or easement may require a bored casing pipe to facilitate main installation. The type of bored casing material and its properties will be specified by the agency granting permission for the crossing. Such crossings are subject to the approval of FCU to avoid conflicts between the requirements or standards between the City and the agency granting permission to cross.
 - a. A letter, permit or approved crossing application from the agency granting permission to cross must be provided to FCU prior to boring.
 - b. The City will not accept any crossings that require an annual user or crossing fee be paid to the agency granting permission to cross. All bored crossing fees, if applicable, shall be paid by the developer prior to boring.
 - c. Valves are required at each end of the boring.

O. Corrosion Control and Cathodic Protection

1. Certain existing water mains within the FCU water transmission and distribution system are equipped with cathodic protection (CP) systems.
 - a. All existing CP test stations shall be shown on the utility plans with notes to protect in place.
 - b. When a new DIP water main is being connected to an existing CP main, the new main must be isolated from the CP main by installing a short section of PVC pipe (See Standard Detail).
 - c. When a new DIP water main is installed and is crossing a CP main, a CP test station may be required to monitor the integrity of the CP system.
2. If the use of DIP water main or steel casing is proposed, the Design Engineer shall have a soil resistivity survey of the construction area performed by a certified Geotechnical Engineer to evaluate the corrosion potential of the soil and to make recommendations on any corrosion protection measures such as pipe type or cathodic protection. The FCU Water Utilities Senior Development Review Engineer will review the soil resistivity report, the Engineer's recommendations and the service history for the water system corrosion in the area and will determine the type of pipe to be used or the type of corrosion protection to be provided prior to approval of the utility plans.

- a. The distance between the soil sample locations for the survey shall be at the discretion of FCU; however, testing frequency shall not be less than one test for every 400 feet of pipe.
 - b. Soil samples shall be taken at pipe depth.
3. All joints on the proposed DIP water main shall be bonded with the use of copper wire exothermically welded to the sections of DIP main.

P. Casing Pipe

1. Casing pipe shall be steel unless otherwise approved by the Water Utilities Senior Development Review Engineer; however, FCU reserves the right to require a specific casing pipe material for any public water main installation.
2. Each casing pipe installation shall be specifically designed by the Design Engineer.
3. If steel casing pipe is to be used, a soil resistivity analysis shall be performed and the need for cathodic protection shall be evaluated in accordance with Section 3.06 O. 2. of this Criteria.
 - a. A 20 pound anode and CP test station is required on both ends on a steel casing pipe. The anode wire and the test station wire shall be exothermically welded to the steel casing pipe.

Q. Phased Installations and Stub-outs

1. If phasing of the water distribution system improvements is proposed by the developer, the phasing shall be clearly defined and shown in the utility plans.
2. The proposed phasing shall maintain looping integrity within the system.
3. The phased system design shall meet all water demands and fire flow requirements for the portion of the development being served.
4. An inline valve and fire hydrant (temporary or permanent) shall be required at the end of each phase or stub-out. The fire hydrant assembly shall be constructed with the hydrant off the side of the street (See for Fire Hydrant Installation Standard Detail).
5. Phased water mains/stub-outs shall be valved such that only one valve needs to be closed when the main is extended and no customers are without service. The valve must be appropriately restrained to prevent the valve from “blowing off” when the water line is exposed and the thrust blocking is removed for extension of the main.
6. Stub-outs not utilized shall be abandoned in accordance with these criteria.

3.07 SEPARATION FROM OTHER UTILITIES AND BUILDINGS

A. Horizontal

1. Wet Utilities: Sanitary sewers, storm sewers, non-potable/reclaimed pipelines, etc. running parallel to a public water main or related appurtenance shall not be closer than 10 feet.
2. District Water Mains: If a water main is proposed to be installed parallel to a District water main, the FCU separation requirement is 10 feet; however, the District should also be contacted to determine if the District has any additional requirements.
3. Dry Utilities: Natural gas, electric, cable TV, telephone/communication, etc. running parallel to a public water main or related appurtenance shall be no closer than 10 feet. In certain situations, there may be some flexibility to this requirement; however, this would be an exception to the normal requirement and would only be allowed with the approval of the FCU Water Utilities Senior Development Review Engineer.
4. Buildings and Structures: Water mains shall be a minimum of 15 feet from all buildings and structures.

B. Vertical – When a water main crosses another public or private utility, irrigation or drainage ditch or natural stream, the crossing design shall protect the water main and other utility’s structural integrity, prevent contamination of the main and mitigate future system impacts and costs of repair. The entity responsible for the utility, ditch, railroad or other structure crossed may also impose additional criteria.

1. All crossings shall be clearly identified and dimensioned on the plan view and profile view on the utility plans.
2. Water Crossing **over** Wastewater/Stormwater/Other non-potable Systems – When a public water main crosses these types of systems, the water main shall cross above with a minimum of 18-inches vertical clearance from the system and maintain the minimum depth of cover required by these Criteria.
 - a. A vertical clearance of less than 18-inches may be allowed with prior approval of the FCU Water Utilities Senior Development Review Engineer. In these cases, all joints of the non-potable utility within 10 feet of the water main shall be wrapped with butyl adhesive tape or all piping of the non-potable system within 10 feet of the water main shall be C900/C905 PVC as required by the FCU Water, Wastewater, Stormwater Development Construction Standards.
3. Water Crossing **under** Wastewater/Stormwater/Other Non-Potable Systems - When a public water main crosses under these types of systems, the water main should maintain 18-inches of vertical clearance from such systems. All joints of the wastewater/stormwater/other non-potable utility within 10 feet of the water main shall be wrapped with butyl adhesive tape or the piping of the non-potable system within 10 feet of the water main shall be C900/C905 PVC as required by the FCU Water, Wastewater, Stormwater Development Construction Standards.

- a. For wastewater, stormwater or other non-potable pipelines 18-inch and larger, the water main shall be installed in a casing pipe. The casing shall extend a minimum of 10 feet beyond each side of the crossing.

3.08 DITCH CROSSINGS

- A. When a water main is crossing a Named Ditch Company, the Developer shall contact the Ditch Company and obtain all permits and approvals for each crossing. In addition to the requirements of these Criteria, the Ditch Company may add to or modify the requirements of these Criteria, provided the requirements are more stringent. All permit/crossing fees and costs shall be paid by the Developer.
 - 1. Steel Casing – The casing shall be of sufficient length so that the ends of the casing may be exposed without excavating in the ditch R.O.W. or easement and a minimum of 10 feet beyond any toe or top of slope to ditch. The steel casing pipe shall be in accordance with Section 3.06 P. of these Criteria.
 - 2. Cut-off Walls – A clay or concrete cut-off wall shall be placed on both ends of the casing pipe. The cut-off wall shall extend to 1 foot above the maximum free surface water elevation of the ditch (or as required by the Ditch Company). (Refer to Standard Details.)
 - 3. Cover – Cover over the casing shall be 3 feet or more from flowline of ditch to top of casing.
 - 4. Ditch Repair – All ditches shall be restored according to the Ditch Company’s requirements.
- B. Valves are required on both sides of the ditch crossing. Valves shall be located back from the crossing or restrained in such a manner as to prevent the valve from “blowing off” when the pipe is disassembled between the valves for maintenance or replacement. No water services shall be connected to the water main between these valves.

3.09 ROUNDABOUT CROSSINGS

- A. Where an existing or proposed water main crosses a roundabout, the following design criteria shall apply:
 - 1. All valves, fittings, fire hydrants, services and appurtenances shall be located outside the center median of the roundabout. It shall be the Developer’s responsibility to relocate any of these existing facilities outside of the center median.
 - a. If there are no water mains connecting from a perpendicular alignment, the water main may be installed in a casing pipe through the roundabout median. It shall be the Developer’s responsibility to re-construct and install any existing water main in a casing.
 - (1) If the water main is installed in a casing, isolation valves shall be installed on both sides of the roundabout 40 feet from each end of the casing and shall be restrained in accordance with the Standard Detail for Restrained

Pipe Lengths for Dead Ends to prevent the valve from “blowing off” when the piping in the roundabout area is disassembled for repair or replacement.

- (2) Approved joint restraint devices shall be used on all pipe joints within a casing pipe.
 - (3) No services or connections are allowed between the isolation valves.
- b. If there are water mains connecting from a perpendicular alignment, all water mains shall be routed around the center median. (See Standard Detail) It shall be the Developer’s responsibility to re-locate any existing water mains.
2. Water service taps shall be located a minimum of 5 feet outside the roundabout center median. It will be the Developer’s responsibility to relocate any service taps outside of the median.

3.10 LANDSCAPE SEPARATION DISTANCES

- A. Trees – Trees shall be a minimum of 10 feet from all water mains and fire hydrants and 6 feet from water services including curb stops and meter pits/vaults.
- B. Shrubs – Shrubs shall be a minimum of 4 feet from water mains, fire hydrants and water services.

3.11 ABANDONMENT OF MAINS AND SERVICES

- A. Any water mains or water services that were installed and will not be used (such as in the case of a replat or change in project layout) shall be abandoned. Services will be required to be abandoned at the main, unless otherwise directed by FCU. This shall include excavating at the main and disconnecting the line to be abandoned as directed by FCU Field Operations Staff. Each situation will be evaluated on a case-by-case basis to determine if the valve at the connection point is to be removed. For a main abandonment, the main shall be abandoned to the last water main connection point or to the last remaining in-service portion of the water main, as determined by FCU. All fire hydrants, valve boxes, curb stops and meter pits/vaults associated with the main being abandoned shall be removed.
- B. When a water main is to be abandoned and the main will not be under a proposed building, the main may be abandoned in place and left in the ground if approved by FCU and labeled accordingly on the City approved utility plans. The abandoned main shall be drained and both ends shall be plugged with concrete. Mains 12-inch and larger shall be flash filled in accordance with the City of Fort Collins - Water, Wastewater, Stormwater Development Construction Standards.
- C. Any existing water services within or adjacent to a site being re-developed that are not being used shall be abandoned at the main as directed by FCU Field Operations Staff. This shall include the removal of the curb stop box or valve box on the abandoned service and removal of any meter pits/vaults.

SECTION 4 – WASTEWATER COLLECTION DESIGN CRITERIA

4.01 GENERAL

These Criteria typically apply to sanitary sewers 15-inch diameter and smaller. Larger sanitary sewers are classified as interceptor sewers. If a development project includes any construction of or modification to an interceptor sewer, contact the FCU Water Utilities Senior Development Review Engineer and the FCU Water Engineering Capital Projects Division for design and construction requirements.

4.02 WATER/WASTEWATER DEMAND ANALYSIS REPORT

In conjunction with the City's Development Review Process, FCU **may** require that the Design Engineer submit a Water/Wastewater Demand Analysis Report at the time of PDP. If the analysis report is required, a meeting with FCU Water Utilities Senior Development Review Engineer must be held to determine the outline and scope of the report.

4.03 WASTEWATER SYSTEM MODELING

If dynamic analysis is needed for proper sizing of sanitary sewers, FCU will assist with the necessary modeling to evaluate the proposed project and associated demands with detailed information provided by the Design Engineer.

4.04 FCU WASTEWATER SERVICE AREA

A. FCU provides wastewater service to a portion of the area inside City limits and other areas to the northwest of the City including parts of the community of Laporte, Colorado. (See Wastewater Utility Service Areas Map in Appendix B for a map current as of the date of adoption of this manual.)

B. Certain portions of Fort Collins receive wastewater service from the following districts:

Boxelder Sanitation District
3201 E Mulberry, Suite Q
Fort Collins, CO 80524
Telephone: 970-498-0604

Cherry Hills Sanitation District
512 N Link Lane
Fort Collins, CO 80524
Telephone: 970-493-6130

South Fort Collins Sanitation District
5150 Snead Drive
Fort Collins, CO 80525
Telephone: 970-226-3104

C. When designing sanitary sewer extensions, it is important to avoid designing/constructing mains which would interconnect with these various utilities.

4.05 WASTEWATER PUMP STATIONS

Pump stations are generally discouraged. FCU currently has no public pump stations in the Wastewater Collection System. If a FCU pump station is to be considered, it must be a regional station serving a large area rather than a station serving an individual subdivision or development. All pump stations must be approved by the Water Engineering and Field Services Manager. If allowed, the details and requirements pertaining to the type, design and construction of the pump station will be determined at that time.

4.06 WASTEWATER COLLECTION SYSTEM DESIGN AND LAYOUT

A. General

1. Each property or lot shall have frontage on public R.O.W. so that any service lines will not cross another property.
2. The design and layout of the system must provide for the extension of the sanitary sewers to adjacent properties that may develop in the future.
3. Utility locations, alignments and separations noted herein are required for new developments and redeveloping areas.
4. It is very important within each development or redevelopment area that the site layout be designed in such a manner that accommodates acceptable access for future maintenance by FCU. This includes providing adequate separation distances from other utilities and structures and providing the easements necessary for future maintenance activities.
5. Sanitary sewers shall extend across the entire frontage of a property unless otherwise approved by FCU.
6. No connections to the wastewater collection system are allowed which would add surface water or groundwater to the wastewater system. This includes roof drains, drainage tiles, foundation drains, area drains, etc.
7. Floor drains internal to covered parking that collect drainage from drippings off parked vehicles or water used for washing down internal floors shall be connected to the sanitary sewer using appropriate sand and oil interceptors. The drainage from the top floor of a parking facility which is subject to runoff caused by precipitation events shall not be discharged to the sanitary sewer system.

B. Hydraulic Design

1. Design Flows: Wastewater design flows shall be the peak daily flow plus wet weather infiltration and inflow (I&I). The per capita or per acre flow contributions and I&I flow contributions are subject to the approval of the FCU Water Utilities Senior Development Review Engineer.
2. Manning's Equation using Mannings Coefficient of $n = 0.013$ shall be used for sizing sewers.

3. Minimum sizes: Minimum size for public sanitary sewers is 8-inch. Minimum size for private sewer services is 4-inch.
4. Depth of Flow: The maximum allowable depth to diameter ratio for sanitary sewer flows at peak flow conditions is $d/D = 0.5$ for sewers up to and including 15-inch. For sewers larger than 15-inch, contact the FCU Water Utilities Senior Development Review Engineer and the FCU Water Engineering Capital Projects Division for design and construction requirements.
5. Velocity: Sanitary sewers shall be designed so that the design flow velocity is at least 2 feet per second and does not exceed 10 feet per second.
6. Slope: The following table gives the minimum and maximum allowable slopes for sanitary sewers. All sanitary sewers shall be designed and constructed with constant slope between manholes.

Diameter (Inches)	Minimum Slope (Percent)	Maximum Slope (Percent)
Services		
4	2.0%	21.0%
6	1.0%	12.2%
Mains		
8	0.40%	8.4%
10	0.28%	6.1%
12	0.22%	4.9%
15	0.15%	3.6%

C. Pipe Material

1. The only pipe material for gravity sanitary sewers currently included in the City of Fort Collins – Water, Wastewater, Stormwater Development Construction Standards is polyvinyl chloride (PVC) pipe. If an alternate material is proposed, it shall be evaluated in accordance with Section 01000 and Section 01600 of the City of Fort Collins - Water, Wastewater, Stormwater Development Construction Standards and Section 1.05 of these Criteria.

D. Alignment

1. Within platted streets, sanitary sewers are typically on the centerline of the street and water mains are a minimum of 10 feet from the sewer. If this location is not possible, the sanitary sewer should be aligned such that the manholes are in the center of a travel lane so as to not be in a wheel path. In those situations, the sanitary sewers must also be a minimum of 5 feet from the curb and gutter.
2. No curvilinear sanitary sewers are allowed.

E. Sewer Depth

1. Minimum cover above top of sanitary sewers shall be 4 feet.
2. Depths greater than 20 feet require approval of the FCU Water Utilities Senior Development Review Engineer and may require greater separation distances from other utilities, structures and landscaping and may require additional easement width.

F. Groundwater Barriers

1. In situations where groundwater is known or found to be above the elevation of the sanitary sewer or if there is a possibility that groundwater may be diverted by the construction of the new water mains and sanitary sewers, groundwater barriers shall be constructed within the sanitary sewer trench to prevent groundwater migration or diversion along the sewer main.
2. Groundwater barriers are typically located upstream of manholes and shall be spaced a maximum of 400 feet apart.
3. Groundwater barriers shall extend through the full depth of the granular bedding/pipe zone material and project 1 foot beyond each side of the trench wall. In addition, the groundwater barrier shall extend to a point 1 foot above the maximum peak wet season subsurface groundwater level but not less than 3 feet above the top of pipe.
4. Groundwater barriers shall be installed on both sides of all natural waterways, ponds, lakes or irrigations ditches.
5. Groundwater barriers shall be shown and labeled on the sanitary sewer plan and profile sheets of the utility plans.

G. Manholes

1. Manholes are required at any change in size, slope or direction of a sanitary sewer, at connecting points with other sanitary sewers and at the end of a sanitary sewer line.
2. When a pipe is stubbed out of a manhole for a future sewer connection, the stub-out shall be no more than 2 feet long.
3. Manholes shall not have less than 90 degrees between incoming and outgoing sanitary sewers.
4. Manholes are required at points where services larger than 6-inch diameter connect to sanitary sewers.
5. Maximum spacing between manholes shall be 500 feet with typical spacing at 400 feet.
6. Manholes shall have a minimum 0.1 foot drop in invert elevation for straight through manholes. Manholes with change in horizontal flow direction greater than 30 degrees

shall have 0.2 foot drop between incoming invert elevation(s) and outgoing invert elevation.

7. Manholes with more than 2 feet between inlet and outlet invert elevations shall be constructed with an outside drop connection.
8. No inside drop connections are allowed.
9. When there is a change in size of sanitary sewer at a manhole, the crowns of the two sewers shall be set at the same elevation. However, if a lateral sanitary sewer is connecting to an interceptor sewer (18-inch or larger in diameter), the invert of the lateral sewer should be set at the crown of the interceptor.
10. Minimum diameter for manholes is listed in the Standard Manhole Detail Drawing. Larger manholes may be required to accommodate multiple incoming mains or large radius horizontal flow channel bends.
11. Manhole invert channels shall be formed with smooth curves having as large a radius as the manhole will permit to minimize turbulence. The flow channel shall be U-shaped with a height equal to three-fourths the diameter of the outgoing sanitary sewer.
12. Manholes shall maintain a minimum clearance of 5 feet from curb and gutter and 10 feet from cross pans to the outside edge of the manhole.
13. If subject to flooding, manhole shall have a bolted, water-tight ring and cover. Bolted, water-tight ring and covers shall be noted and labeled on the sewer plan and profile drawings.
14. When connection is proposed to an existing manhole, FCU will assess the condition of the manhole to determine if special construction, repair or replacement by developer will be required.
15. All connections to existing manholes shall be made by core drilling and grout sealing the opening into the manhole above the manhole bench. The Design Engineer shall use the elevation of the top of the bench as the starting elevation for the new sewer, or if connecting to an interceptor sewer, use the criteria contained in 4.06 G. 9. When connection is above the manhole bench, add a note to construct/form a new invert to direct the flow to the existing, main channel.
16. All weather access roads shall be required to manholes located outside of street R.O.W. Access roads shall be a minimum of 15 feet wide and designed and constructed to support maintenance vehicles weighing 40 tons. Carsonite marker posts (provided by FCU) shall be placed at all manholes outside of street R.O.W.

H. Services

1. General

- a. Within the R.O.W., services shall be perpendicular to the sanitary sewer main.
- b. Sanitary sewer services shall be a minimum of 10 feet from all water services.
- c. Sanitary sewer services shall not be installed in trenches with other utilities.
- d. Sanitary sewer services for a given property must be installed on the sanitary sewer main within the confines of the property lines extended.
- e. Cleanouts are required at all changes in vertical or horizontal alignment and at 100' maximum intervals.
- f. Mixed use buildings must have separate sewer services for the residential and commercial portions of the building.
- g. Sanitary sewer services are not allowed to connect at manholes unless approved by FCU Water Utilities Senior Development Review Engineer.
- h. For sanitary sewer services 8-inch or larger, a manhole is required at the point of connection.
- i. Connection of 6-inch service to an 8-inch sewer must be made by cutting in a tee or wye fitting or installing a manhole.
- j. Sanitary sewer services that are not used shall be abandoned at the main in accordance with Section 4.11 of these Criteria.

2. Residential

- a. Single Family
 - (1) Each single family lot shall have a separate sewer service line connecting directly to a FCU sanitary sewer without crossing another property.
 - (2) Services shall be located in the downstream portion of each lot a minimum of 10 feet from the water service for that portion located within public R.O.W. or easement.
- b. Single Family with Carriage House
 - (1) On a single family lot, sewer service may be extended from the principal residence to a carriage house if approved by FCU, if the sewer service has adequate capacity for both buildings and if the buildings are on a single platted lot under single ownership, and as otherwise consistent with City Code.
- c. Duplex
 - (1) Each dwelling unit in a duplex shall have a separate sewer service extending from an FCU sanitary sewer main.
- d. Multi-Family
 - (1) Each multi-family building shall have a separate sewer service connecting directly to a FCU sanitary sewer without crossing another property; however, FCU may require a multi-family building to have more than one service.
- f. Single Family Attached Dwellings
 - (1) For single family attached dwellings where each dwelling unit is on a separate platted lot, each unit must have a separate sewer service with cleanout; however, if approved by FCU, a common, private sewer service can be extended across property lines to serve up to six units. (See City Code Section 26-256)

g. Non-Residential

- (1) Each non-residential building shall have a separate sewer service connecting directly to a FCU sanitary sewer without crossing another property; however, FCU may require a non-residential building to have more than one service.
- (2) Monitoring manholes may be required on services from non-residential facilities with high-strength waste.
- (3) Grease interceptors are required on the services for all restaurants and facilities with commercial kitchens.
- (4) Sand and oil interceptors are required on services from facilities with indoor auto service bays and from services from the portions of parking garages that do not collect runoff from rainfall or snow melt.
- (5) Details for grease interceptors and sand and oil interceptors are included in the City of Fort Collins - Water, Wastewater, Stormwater Development Construction Standards.

I. Subdrains

1. Subdrains shall not be connected to the wastewater collection system. Subdrains shall only discharge to the storm drainage system or designed detention areas.
2. Subdrains may be permitted in public R.O.W. If allowed, the Developer shall be required to submit a soils investigation and report as outlined in Chapter 5 of the LCUASS for review and approval by the City Engineering Department.
3. Subdrains built in the public R.O.W. for private drainage shall be private improvements and shall include provisions for maintenance by the local homeowners association or other private entity.
4. Subdrains shall meet the requirements contained in Chapter 12 of the LCUASS.

J. Borings

1. Sanitary sewers through City of Fort Collins or another agency's R.O.W. or easement may require a bored casing pipe to facilitate main installation or replacement. The type of bored casing material and its properties will be specified by the agency granting permission for the crossing. Such crossings are subject to the approval of FCU to avoid conflicts between the requirements or standards between the City and the agency granting permission to cross.
 - a. A letter, permit or approved crossing application from the agency granting permission to cross must be provided to FCU prior to boring.
 - b. The City will not accept any crossings that require an annual user or crossing fee be paid to the agency granting permission to cross. All bored crossing fees, if applicable, shall be paid by the developer prior to boring.

K. Casing Pipe

1. Casing pipe shall be steel unless otherwise approved by the Water Utilities Senior Development Review Engineer; however, FCU reserves the right to require a specific casing pipe material for any public sewer main installation.
2. Each casing pipe installation shall be specifically designed by the Design Engineer.
3. If steel casing pipe is to be used, a soil resistivity analysis shall be performed and the need for cathodic protection shall be evaluated in accordance with Section 3.06 O. 2. of these Criteria.
 - a. A 20 pound anode and CP test station is required on both ends on a steel casing pipe. The anode wire and the test station wire shall be exothermically welded to the steel casing pipe.

L. Phased Installations and Stub-outs

1. If phasing of the wastewater collection system improvements is proposed by the developer, the phasing shall be clearly defined and shown in the utility plans.
2. The phased system shall be designed for full build out of the development being served including any additional offsite flows that must be passed through the development.
3. The stub-out design and installation shall maintain the vertical and horizontal alignment in accordance with these Criteria and with the City approved utility plans.
4. The system shall be designed such that a manhole is located at the phase line between portions of the development or the sanitary sewer shall be extended to the next manhole with the phase under construction
5. Sanitary sewer main stub-outs not utilized shall be abandoned in accordance with these Criteria.

4.07 SEPARATION FROM OTHER UTILITIES

A. Horizontal

1. Water mains and storm drains shall be a minimum of 10 feet horizontally from any part of the FCU wastewater collection system.
2. Dry Utilities (Natural gas, electric, cable TV, telephone/communication, etc.) shall be a minimum of 10 feet horizontally from any part of the public wastewater collection system.

B. Vertical – When a sanitary sewer crosses another public or private utility, irrigation or drainage ditch or natural stream, the crossing design shall protect the sanitary sewer and other utility's structural integrity, prevent contamination of the main and mitigate future

system impacts and costs of repair. The entity responsible for the utility, ditch, railroad or other structure crossed may also impose additional criteria.

1. All crossings shall be clearly identified and dimensioned on the plan view and profile view on the utility plans.
2. Sanitary Sewer **Over or Under** a Water Main – See Section 3.07 of these Criteria.
3. Sanitary Sewer Crossing **Over** Storm Drainage Systems – When a public sanitary sewer crosses over a storm sewer, the sanitary sewer should cross above with a minimum of 18-inches vertical clearance from the storm drain system and maintain the minimum depth of cover required by these Criteria.
 - a. A vertical clearance of less than 18-inches may be allowed with prior approval of the FCU Water Utilities Senior Development Review Engineer.
4. Sanitary Sewer Crossing **Under** Storm Drainage System - When a public sanitary sewer crosses under a storm drain, the sanitary sewer should have a minimum of 18-inches of vertical clearance from the storm drain.
 - a. A vertical clearance of less than 18-inches may be allowed with prior approval of the FCU Water Utilities Senior Development Review Engineer.
 - b. For storm drains 24-inch and larger, the sanitary sewer shall be installed in a casing pipe.

4.08 DITCH CROSSINGS

- A. When a sanitary sewer is crossing a Named Ditch Company, the Developer shall contact the Ditch Company and obtain all permits and approvals for each crossing. In addition to the requirements of these Criteria, the Ditch Company may add to or modify the requirements of these Criteria, provided the requirements are more stringent. All permit/crossing fees and costs shall be paid by the Developer.
 1. Steel Casing – The casing shall be of sufficient length so that the ends of the casing may be exposed without excavating in the ditch R.O.W. or easement and a minimum of 10 feet beyond any toe or top of slope to ditch. The steel casing pipe shall be in accordance with Section 4.06 K. of these Criteria.
 2. Cut-Off Walls – A clay or concrete cut-off wall shall be placed on both ends of the casing pipe. The cut-off wall shall extend to 1 foot above the maximum free surface water elevation of the ditch (or as required by the ditch company). (Refer to Standard Details.)
 3. Cover – Cover over the casing shall be 3 feet or more from flowline of ditch to top of casing.
 4. Ditch Repair – The ditch being crossed shall be restored in accordance with the ditch owner’s requirements.

4.09 ROUNDABOUT CROSSINGS

- A. Where an existing or proposed sanitary sewer crosses a roundabout, the following design criteria shall apply:
 - 1. Manholes shall be located outside of the center median of the roundabout and in the center of a travel lane.
 - a. If there are no sanitary sewers connecting from a perpendicular alignment, the sewer shall be installed in a casing pipe through the roundabout median. It shall be the Developer's responsibility to re-construct and install any existing sewers in a casing. Approved joint restraint devices shall be used on all pipe joints within a casing pipe.
 - b. If there are sanitary sewers connecting from a perpendicular alignment, all sewers shall be routed around the center median with all manholes located in the center of a travel lane. It shall be the Developer's responsibility to re-locate any existing sewers.
 - 2. Sewer service taps shall be located a minimum of 5 feet outside the roundabout. It will be the Developer's responsibility to relocate any existing service taps outside of the roundabout.

4.10 LANDSCAPE SEPARATION DISTANCES

- A. Trees – Trees shall be a minimum of 10 feet from sanitary sewers and 6 feet from sewer services.
- B. Shrubs – Shrubs shall be a minimum of 4 feet from sanitary sewers and sewer services.

4.11 ABANDONMENT OF MAINS AND SERVICES

- A. Any sanitary sewers that were installed and will not be used (such as in the case of a replat or change in project layout) shall be abandoned at a manhole. This shall include excavating at an existing manhole, disconnecting and plugging the line to be abandoned as directed by FCU Field Operations Staff. Each situation will be evaluated on a case-by-case basis to determine if other special requirements will apply.
- B. All manholes on an abandoned sanitary sewer shall be removed and the ends of the sanitary sewer shall be plugged with concrete.
- C. When a sanitary sewer is to be abandoned and will not be under a proposed building, the sanitary sewer may be abandoned in place and left in the ground if approved by FCU and labeled accordingly on the City-approved utility plans. The ends of the sanitary sewer shall be plugged with concrete. Sanitary sewers 12-inch and larger shall be flash filled in accordance with the City of Fort Collins - Water, Wastewater, Stormwater Development Construction Standards.
- D. Any existing sewer services within or adjacent to a site being re-developed that are not being used shall be abandoned at the main as directed by FCU Field Operations Staff.

Appendix A – Utility Plan Checklist

Fort Collins Utilities Water and Wastewater Design Criteria

Water/Wastewater Utility Plan Checklist

Items below specified with “FP” are only required at the time of Final Development Plans. All other items are required to be provided in both the PDP and FDP plan submittals.

Overall Utility Plan

Included	N/A	Requirements
_____	_____	R.O.W. lines, property lines and easements
_____	_____	Curb and gutter, cross-pans, sidewalks (attached or detached) and medians
_____	_____	Water: Existing and proposed distribution system facilities including valves, hydrants, bends, lowerings, crossings, services, meter pits/vaults, sizes of all mains/services with detailed labeling for all items
_____	_____	Wastewater: Existing and proposed collection system facilities including manholes, services, crossings, sizes of all mains/services With detailed labeling for all items
_____	_____	Dry Utilities: Existing and proposed gas, electric, telephone, cable, etc.
_____	_____	Proposed private subdrains (where applicable)
_____	_____	Irrigation ditches
_____	_____	Match lines with corresponding sheet numbers referenced
_____	_____	Water/sanitary sewer main abandonments
_____	_____	FP – Development/construction phasing lines

Water Plan (and Profile when applicable)

Included	N/A	Requirements
_____	_____	R.O.W. lines, property lines and easements with dimensions
_____	_____	Existing and proposed streets, curb and gutter, sidewalks, medians, cross-pans, intakes and other structures
_____	_____	Existing and proposed water mains, services/curb stops/meter pits (including irrigation), valves, fittings, fire hydrants, connections to existing system and all appurtenances with detailed labeling for construction
_____	_____	Existing and proposed sanitary sewer mains, services and all appurtenances
_____	_____	Existing and proposed storm sewers and all appurtenances
_____	_____	Proposed private subdrains and cleanout locations
_____	_____	Existing and proposed dry utilities (e.g. gas, electric, telephone, cable, etc.)
_____	_____	Locations of fixed objects (e.g. trees, poles, fences, etc.)
_____	_____	Irrigation ditches
_____	_____	Match lines with corresponding sheet numbers referenced
_____	_____	Utility crossings labeled with sizes, elevations and clearances
_____	_____	Lowerings showing fittings or sweeps with dimensions and elevations
_____	_____	Casing pipes with material, diameter, thickness and length noted
_____	_____	Abandonment of water mains
_____	_____	Cathodic Protection (CP) systems on existing mains including the location of CP test stations
_____	_____	FP - Lengths of water main between valves, fittings, hydrants, etc.
_____	_____	FP - Restrained pipe lengths for thrust restraint at all fittings, lowerings, dead ends, etc.
_____	_____	FP - Pipe or street centerline longitudinal stationing
_____	_____	FP - For water mains 12-inch and larger, provide water main profile drawings showing existing and proposed ground surfaces with water main depths labeled, existing and proposed utility crossings and all pertinent underground features or information
_____	_____	FP - Development/construction phasing lines

Effective Date: __/__/____

Wastewater Plan and Profile

Included	N/A	Requirements
_____	_____	R.O.W. lines, property lines and easements with dimensions
_____	_____	Existing and proposed streets, curb and gutter, sidewalks, medians, cross-pans, storm intakes and other structures
_____	_____	Existing and proposed sanitary sewers, services, connections to existing system and all appurtenances
_____	_____	Existing and proposed water mains, services/curb stops/meter pits (including irrigation), valves, fittings, fire hydrants, connections to existing system and all appurtenances
_____	_____	Existing and proposed storm sewers and all appurtenances
_____	_____	Proposed private subdrains and cleanout locations
_____	_____	Existing and proposed dry utilities (e.g. gas, electric, telephone, cable, etc.)
_____	_____	Locations of fixed objects (e.g. trees, poles, fences, etc.)
_____	_____	Irrigation ditches
_____	_____	Match lines with corresponding sheet numbers referenced
_____	_____	Abandonment of sewers
_____	_____	Utility crossings labeled with sizes, elevations and clearances
_____	_____	Casing pipes with material, diameter, thickness and length noted
_____	_____	FP – Profile of all sanitary sewers
_____	_____	FP - Length of sewer between manholes and longitudinal stationing on manholes and services with detailed labeling for construction
_____	_____	FP - Manhole rim and inflow/outflow invert elevations
_____	_____	FP - Existing and proposed ground surface
_____	_____	FP - Encasement as required when sanitary crosses above a water main
_____	_____	FP - Groundwater barriers where applicable
_____	_____	FP - Development/construction phasing lines

Detail Sheets

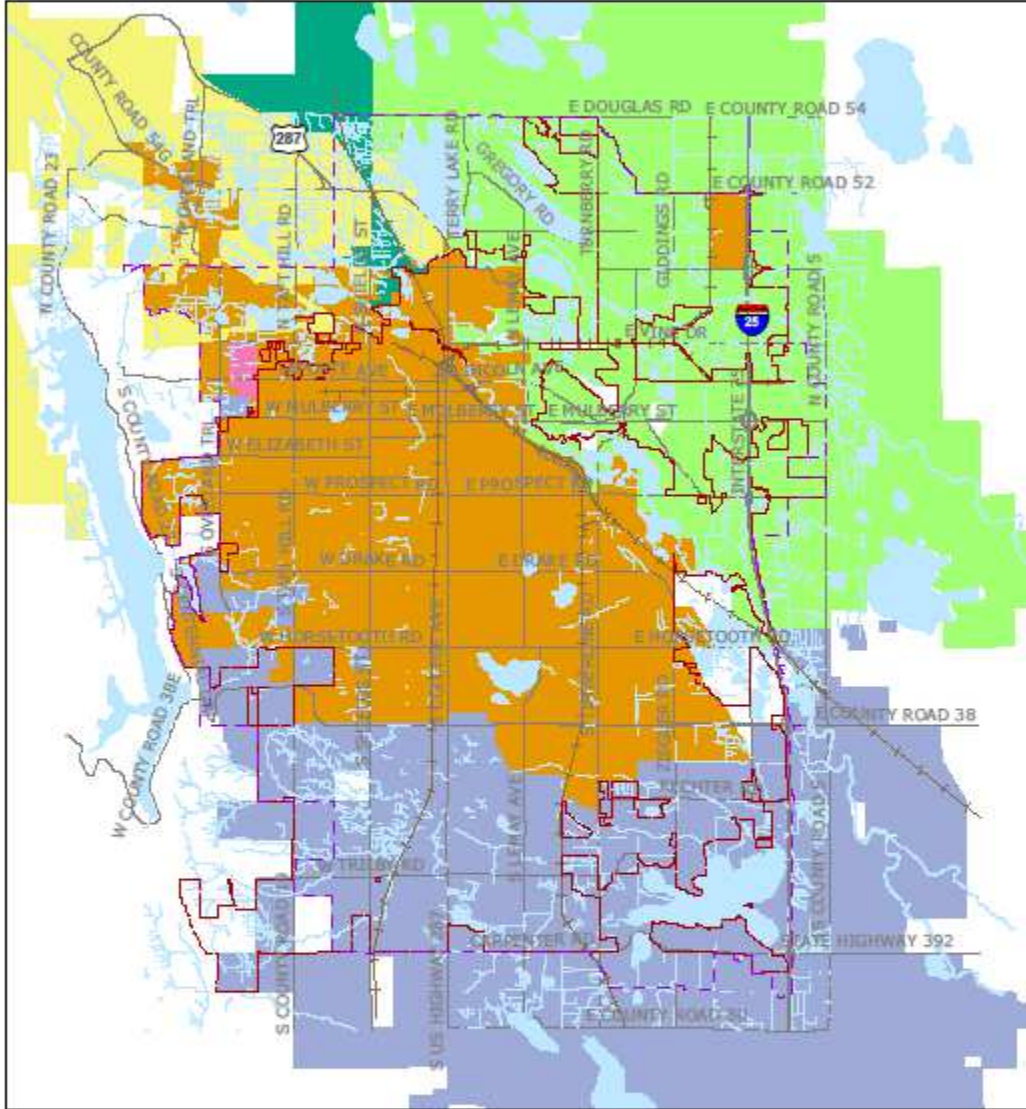
Included	N/A	Requirements
_____	_____	Applicable City of Fort Collins Utilities water, sanitary sewer and stormwater details
_____	_____	Details of special connections, crossings or construction specific to this project

Effective Date: __/__/____

Appendix B - Utility Maps

**Water Utility Service Areas
Water Pressure Zones
Wastewater Utility Service Areas**

Water Utility Service Areas

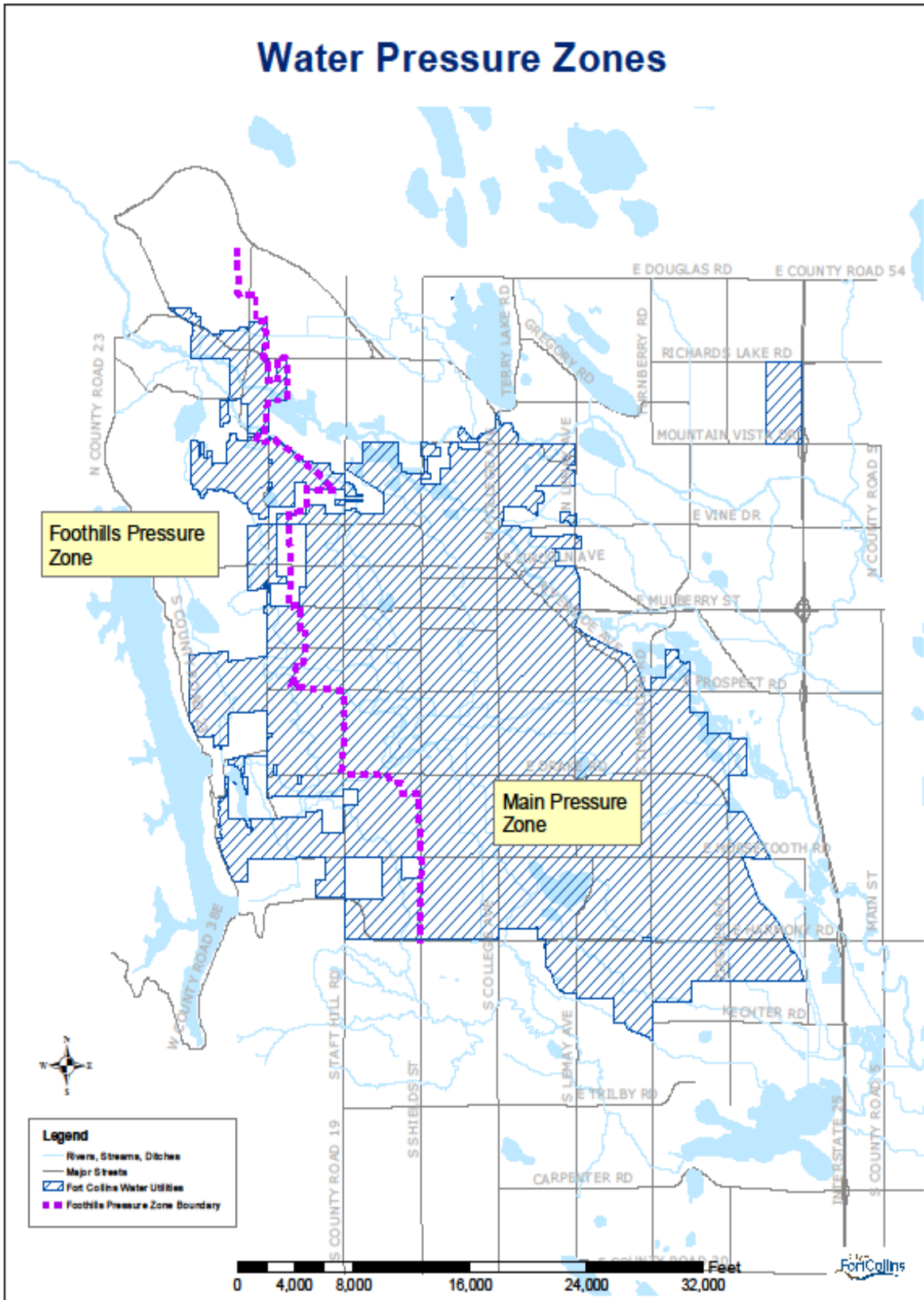


Water Districts

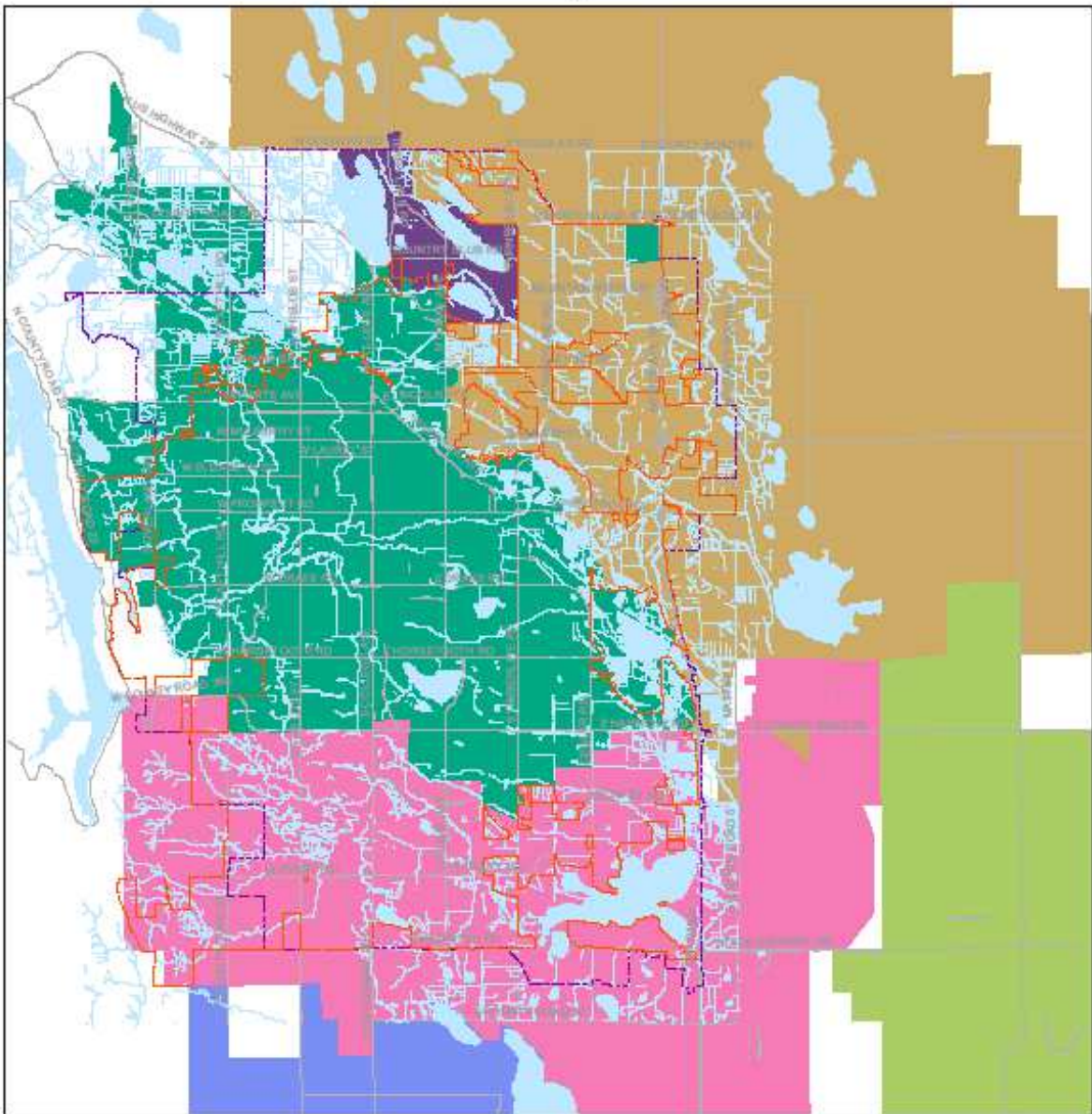
- ELCO Water District
- Fort Collins Loveland Water District
- Fort Collins Utilities (Water)
- Northern Colorado Water Association
- Sunset Water District
- West Fort Collins Water District
- Water Features
- GMA
- Major Streets
- City Limits
- Railroad



Water Pressure Zones

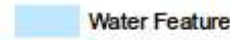



Wastewater Utility Service Areas



Sewer Districts

- | | |
|---|--------------------|
|  | Loveland |
|  | Boxelder |
|  | Cherry Hills |
|  | Fort Collins |
|  | South Fort Collins |
|  | Wellington |
|  | Windsor |

- | | |
|---|------------------------|
|  | Water Features |
|  | City Limits |
|  | Growth Management Area |
|  | Major Streets |

