Utility Criteria Manual
SECTION 1 – WATER, REUSE WATER, AND WASTEWATER
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SECTION I – WATER, REUSE WATER, AND WASTEWATER

1.1.0. GENERAL

The following information is intended to assist engineers and the general public in the design and construction of water, reuse water and wastewater facilities. Information herein is to provide minimum standards for the City of Round Rock (City) requirements only. Sound engineering judgment shall be exercised to determine if these minimum requirements must be exceeded for a particular engineering design. All water, reuse water and wastewater design and construction must comply with the requirements of the State of Texas.

When there is a conflict between State requirements and those contained herein, the more restrictive shall govern.

1.2.0 PRIVATE PLUMBING

1.2.1. Plumbing Inspections

All private plumbing installations connecting to the City's water, wastewater, and/or reuse water systems shall be inspected by the Building Inspection Division to insure compliance with all applicable City ordinances and the latest edition of the International Plumbing Code adopted by the City Council.

1.3.0. CONSTRUCTION PLAN INFORMATION AND SUBMITTAL REQUIREMENTS

1.3.1. General Information

A. Construction plans for water, reuse water, and/or wastewater installation shall be submitted to the appropriate City office for approval or permit issuance. Approval or permit issuance for construction plans will expire if construction does not commence within two years from the date of acceptance. Resubmitted plans must include and comply with all design and construction criteria in effect at the time they are resubmitted.

B. Where appropriate, prior approval of a Municipal Utility District (MUD), Water Control and Improvement District (WCID) or private utility corporation may be required.

C. Plans submitted must show approved easements and/or permits on highway and/or railroad crossings.

D. A signature on the plans by the appropriate City official constitutes approval of the plans.

E. Plans associated with a site development or subdivision improvement must have approval from the DSO. Plan submittal requirements must meet the Development Application Packet appropriate to the submittal type.

F. All water, reuse water and/or wastewater plans will include the following items:

1. Engineer's dated signature and seal of a Professional Engineer licensed in the State of Texas on each plan sheet.
2. Date of plans and revisions.
3. North arrow and scale shall be shown. The standard horizontal scale shall be 1" = 50', 40', 20', or 10' (plan view) with respective vertical scale 1" = 5', 4' or 2', or 1' (profiles). Scales used on each plan and profile sheet shall be the same. For sheets other than plan and profile, a horizontal scale of 1" = 50', 40', 20', or 10' may be used as appropriate. The City may require a larger-scale be used for plan and profile sheets, or a large-scale blowup of a particular area.
4. A general location map.
5. Standard City Water and Wastewater construction notes can be found in the City's Design and Construction Standards (DACS) - General Guidelines.
6. Volume and page number, recorded or proposed easements, public utility easements and any temporary working space/easements.
7. Size, slope, pipe material and location of main with respect to easements, rights-of-way, and property lines.
8. Property lines and dimensions, legal description, lot and block numbers, rights-of-way dimensions, curbs, sidewalks, pavements, power poles, trees, and other plan metric features, locations, and street names.
9. Location, vertical and horizontal, size and material of all existing water, reuse water and wastewater mains, lines and services. The direction of flow in the wastewater mains shall be indicated.
10. All water mains eight (8) inches in diameter and larger shall be profiled.
11. Location, vertical and horizontal, size and description of other utilities where they may conflict with water, reuse water or wastewater mains or other service lines shall be shown in both the plan and profile.
12. Curve data for roads, property lines, water, reuse water and wastewater lines.
13. Final plat recording.
14. Street address for all existing structures shall be shown on the lot(s) where the structures are located.

15. Pressure zone designation for subject tract and zone boundaries where applicable.

G. The following items may be required prior to plan approval or permit issuance:

1. TxDOT permit;
2. Railroad permit;
3. Gas Company permit;
4. Easement acquisition, with volume and page or document number shown on plans;
5. County approval;
6. Water District approval;
7. MUD approval;
8. Texas Department of Health (TDH) approval;
9. Texas Commission on Environmental Quality (TCEQ) approval;
10. Water/Wastewater availability letter

1.3.2. Water System Plans

A. All plan view drawings shall include all applicable items listed in Section 1.3.1.-F. above plus the following:

1. Stations of all connections to existing or proposed water mains and method of connection (e.x. tapping sleeve, cut-in-tee, etc.)
2. For connections to water mains or facilities to be constructed by others, identify the project by name and the design engineer.
3. Station numbers for mains shall be identified for beginning points, ending points, points of curvature, points of tangency, points of reverse curve, points of intersection, valves, fire hydrants, other appurtenances and grade breaks.
4. Station numbers shall be identified for the water and reuse water mains where they cross any other utility.
5. Details of appurtenances shall be shown.
6. The location of all existing and proposed water services, water mains, reuse water mains, valves and fire hydrants shall be identified.
7. Ultimate 1% annual chance (ultimate 100-year) flood plain limits shall be shown.
8. Design velocity at maximum day plus fire flow and at peak hour.
9. Calculated design pressure at highest and lowest lot served shall be shown. These pressures shall be a minimum of thirty five (35) pounds per

square inch (psi) at peak hour demand and a maximum of one hundred ten (110) psi static pressure.

10. Thrust blocking and pipe joint restraints, shall be noted on the plan and profile.

11. Joint deflection angle and fitting angle shall be noted on the plans.

12. Retaining walls, including geogrid, straps, tiebacks and all other components.

13. Culverts, bridges and other drainage structures.

B. A profile view shall be provided for all water mains eight (8) inches in diameter and larger, a profile shall be provided for smaller diameter waterlines as required due to depth or crossing conflicts. The profile must show all applicable items listed in the Design and Construction Standards General Guidelines plus the following:

1. The existing ground profile, proposed finish grade, and subgrade if under pavement.

2. Station numbers and elevations of all utility crossings. Identify size and type of utility being crossed, and clearance between the two utilities.

3. Station numbers and soil geology information at stream crossings to evaluate the need for special surface restoration.

4. Identify pipe size, percent grade, pipe material, including American Society for Testing and Materials (ASTM) and/or AWWA designation, fittings, bends, and deflections to be used. If an alternate material are to be allowed, both shall be listed (example "D.I., Class 150 or PVC, Class 150").

5. Station numbers and elevations for starting points, ending points, point of intersection, grade breaks, valves, fire hydrants, air release valves, pressure/flow regulating valves and at intermediate points not exceeding fifty (50) feet.

6. Joint deflection angle and fitting angles shall be noted.

7. Retaining walls, including geogrid, straps, tiebacks and all other components.

8. Culverts, bridges and other drainage structures.

1.3.3. Wastewater System Plans

A. All plan view drawings shall include all applicable items listed in Section 1.3.1.F. above plus the following items:

1. Station numbers at all proposed connections to existing or proposed wastewater mains and method of connection.

2. For proposed connections to wastewater mains or facilities to be

constructed by others, identify the project name and the design engineer.

3. The location, alignment and structural features of the wastewater main, including manholes and concrete retards, if applicable.

4. Station numbers for beginning points, ending points, manholes, clean-outs and other appurtenances.

5. Details of all required appurtenances.

6. Location of all existing and proposed wastewater services, mains and manholes.

7. Ultimate 1% annual chance flood plain limits.

8. Retaining walls, including geogrid, straps, tiebacks and all other components.

9. Culverts, bridges and other drainage structures.

B. A profile view shall be provided for all wastewater mains and shall include all applicable items listed in Section 1.3.1.G. above, plus the following:

1. The existing ground profile, proposed street finish grade and subgrade, or finished grade if not under pavement.

2. Station numbers and elevations of all utility crossings. Identify size and each type of utility being crossed and clearance between the two utilities.

3. Station numbers and soil geology information at stream crossings to evaluate the need for special surface restoration.

4. Identify the pipe size, percent grade and pipe material to be used including ASTM and/or AWWA designation. If an alternate material is to be allowed, both shall be listed (example "PVC SDR 26 or pressure class 160").

5. Station numbers, flow lines and elevations for starting points, ending points, manholes, clean-outs, and at intermediate points not exceeding fifty (50) feet.

6. Elevations shall be indicated on the profile showing the finish floor elevations of all existing structures. If the structure has an active septic tank or other disposal system, the flow line elevation of the plumbing where it exits from the structure is to be indicated. If a lot or tract is vacant, side shots may be required from the middle of each lot to ensure gravity service is possible from the lot to the main.

7. Design flows, minimum and maximum, and flow velocities at minimum and maximum dry weather flows.

8. Retaining walls, including geogrid, straps, tiebacks and all other components.

9. Culverts, bridges and other drainage structures.

1.3.4 Reuse System Plans

A. All plan view drawings shall include all applicable items listed in Section 1.3.1.F. above plus the following:

1. Stations numbers at all connections to existing or proposed reuse water mains and method of connection (ex. tapping sleeve, cut-in-tee, etc.).
2. For connections to reuse water mains or facilities to be constructed by others, identify the project by name and the design engineer.
3. Station number for mains shall be identified for beginning points, ending points, points of curvature, points of tangency, points of reverse curve, points of intersection, valves, other appurtenances and grade breaks.
4. Station numbers shall be identified for the reuse water mains where they cross any other utility.
5. Details of appurtenances shall be shown.
6. The location of all existing and proposed reuse water services, water services, reuse water mains, water mains, valves, and fire hydrants shall be identified.
7. Ultimate1% annual chance (ultimate 100-year) flood plain limits shall be shown.
8. Design capacities and velocities shall be shown.
9. Thrust blocking and pipe joint restraints, shall be noted on the plan and profile.
10. Retaining walls, including geogrids, straps, tiebacks and all other components.
11. Joint deflection angle and fitting angles shall be noted.
12. Culverts, bridges and other drainage structures.

B. A profile view shall be provided for all reuse water mains twelve (12) inches in diameter and larger, a profile shall be provided for smaller diameter reuse lines as required due to depth or crossing conflicts. The profile must show all applicable items listed in the Design and Construction Standards General Guidelines plus the following:

1. The existing ground profile, finish grade and subgrade if under pavement.
2. Station numbers and elevations of all utility crossings. Identify size and type of utility being crossed, and clearance between the two.
3. Station numbers and soil geology information at stream crossings to evaluate the need for special surface restoration.
4. Identify pipe size, percent grade, pipe material, fitting, bends, and deflections to be used including American Society for Testing and

Materials (ASTM) and/or AWWA designation. If an alternate material is to be allowed, both shall be listed.

5. Station numbers and elevations for starting points, ending points, points of intersection, grade breaks, valves, fire hydrants, air release valves, pressure/flow regulating valves and intermediate points not exceeding fifty (50) feet.
6. Retaining walls, including geogrids, straps, tiebacks and all other components. Joint deflection angle and fitting angles shall be noted.
7. Culverts, bridges and other drainage structures.
8. Identify “purple pipe” for PVC piping or “purple wrapped” for DI and Steel piping. All above ground reuse piping must be painted purple and have appropriate warning signs per 30 TAC 210 and 30 TAC 244.

1.4.0. CONSTRUCTION INSPECTION AND CITY ACCEPTANCE

1.4.1. Construction Inspection Procedure

A. Prior to commencement of any construction, the developers or their design engineer shall attend a Pre-Construction Conference between the City, the Contractor, other utility companies, any affected parties and any other entity the City may require. To schedule a Pre-Construction Conference, the design engineer shall contact the appropriate City department.

1.5.0. ABANDONMENT OF FACILITIES

If a new project will result in the abandonment of existing facilities, the plans shall provide for the appropriate abandonment of these facilities.

1.5.1. Mains

Abandonment of all water, reuse water, and wastewater mains in public or private easements shall include the filling in the main with a flowable fill or slurry and meeting requirements of the current specifications. Plans shall include method of abandoning all lines that cannot be abandoned in this fashion.

1. 5.2. Manholes

The abandoned manholes shall be removed to a level not less than two (2) feet below grade, including the entire cone section. Inlets and outlets shall be securely plugged, with grout for a minimum of 12” beyond the outside wall of the manhole and the structure filled with stabilized sand or granular material that is no greater than 1-1/2” maximum size. Manhole abandonment must comply with City of Round Rock detail.

1.5.3. Lift Stations

Abandonment of lift stations shall include the removal of all pumps, motors, couplings, valves, and controls from the dry well and all appurtenances above finished grade. Both the wet well and dry well shall be cut down four (4) feet below grade, filled with cement stabilized sand, and covered with top soil to grade. The associated force main shall be properly abandoned (see 1.6.1 above). This includes cutting and plugging both ends and/or grouting main as appropriate.

All disturbed areas shall be re-vegetated. The City shall be notified prior to abandonment.

1.5.4. Service Lines

All water service lines, including fire lines that are being abandoned shall be disconnected at the corporation stop or valve. Valve or corporation stop shall be closed, plugged, and covered with concrete thrust blocking. All other valves and appurtenances shall be removed.

1.6.0. DESIGN REQUIREMENTS FOR WATER, WASTEWATER, AND REUSE WATER SYSTEMS

1.6.1. Introduction

These guidelines are intended to establish the minimum basic design requirements for water, reuse water and wastewater systems within the City and its ETJ. They do not cover the requirements for water, reuse water, or wastewater treatment plants.

The following information is provided to assist engineers and the general public in the design and construction of water and wastewater facilities within the City's ETJ. All plans for such facilities shall be prepared by or under the supervision of a Professional Engineer, licensed in the State of Texas. It will be the responsibility of the engineer to ensure that the plans are in compliance with the latest versions of all applicable federal, state and local ordinances, rules and regulations.

These include, but are not limited to, the following:

A. Design Criteria for Sewage Systems - TCEQ.

B. Rules and Regulations for Public Water Systems - TCEQ.

C. Edwards Aquifer Rules - TCEQ

D. City of Round Rock Ordinances

E. Most Current City Standard Construction Details

F. City DACS

G. State of Texas Board of Professional Engineers

The design engineer shall prepare construction drawings in conformance with City requirements and accepted engineering practice, but also with consideration of future

maintenance and operational concerns.

The following are specific criteria the design engineer shall use in his/her design. Where conflict exists between State or Federal codes and City criteria, the more restrictive shall govern. The criteria below are intended as a guide for the design engineer and are not intended to be an exhaustive list. All items may not apply in all cases.

1.6.2 Water Systems

Plans shall be submitted and sealed by a Professional Engineer licensed by the State of Texas which will certify that the system has been designed in accordance with the requirements set forth below and conform to the rules, regulations, and requirements established by the TCEQ Design Criteria in Chapter 290 of the Texas Administrative Code, as amended.

A. Size/Capacity Determination

1. General

   a. Hazen Williams Friction Coefficient C = 110, higher C coefficient may be used for new mains only upon approval by the City with sufficient documentation to show effects of long-term use.

   b. Average day demand = two hundred three (203) gal/person/day

   c. Peak day demand = four hundred six (406) gal/person/day

   d. Peak hour demand = eight hundred ninety three (893) gal/person/day

   e. Maximum static pressure equals one-hundred (100) psi unless otherwise approved by the City (fire hydrants will have attached a pressure- reducing valve (PRV) where pressure exceeds one-hundred ten (110) psi)

   f. If the maximum static pressure exceeds eighty (80) psi, a PRV will be required on the property owner's side of the water meter and shall be shown on the plan view.

   g. Minimum operating pressure is fifty (50) psi at the highest elevation meter location using average day demand.

2. Peak Hour Demand Requirements

   a. The maximum allowable velocity shall not exceed eight (8) feet per second (fps).

   b. The minimum pressure at any point in the affected pressure zone must not be less than thirty-five (35) psi.

3. Emergency Demand (Fire Flow) Requirements

   a. The maximum allowable velocity shall not exceed ten (10) fps.

   b. Fire flow (reference current International Fire Code, as amended and

adopted) requirements will be determined in accordance with the City Fire Code and associated rules.

c. The minimum residual pressure at any point in the affected pressure zone at peak day plus fire flow must not be less than twenty (20) psi.

4. Sizing of Water Mains

All water mains shall be installed in accordance with the Water Master Plan adopted by the City. Computer modeling shall be required for sizing water mains on a case-by-case basis. However other engineering calculation methods may be considered to size water mains that are less than sixteen (16) inches in diameter. (However, no water main shall be sized smaller than the diameter shown in the City's Water Distribution System Master Plan or as determined utilizing the City's Water Distribution System Water Model.) The largest diameter, as determined by comparing the service area's peak hour demand and peak day plus fire flow demand, shall be used. All water mains shall be sized to provide necessary service to the tract being developed. The City may require oversizing of certain mains in accordance with City ordinances.

5. Storage Requirements

If it is determined by the City that additional storage is required, the following criteria shall be used:

Effective Storage	=	100 gal/person
Emergency Storage	=	100 gal/person
TOTAL STORAGE	=	200 gal/person

Effective Storage is defined as storage that will provide a minimum of fifty (50) psi of pressure at the highest service elevation in pressure zone.

The Engineer may be required to provide computer simulations as determined on a case-by-case basis.

B. Mains

1. Minimum main size shall be eight (8) inches unless the City approves a smaller size. The minimum size will be governed by various factors which include fire protection requirements, high density land usage, and the designer's consideration of general system gridding, future transmission mains, neighboring developments and area configuration. Looped systems with more than one feed are required for service reliability. An Intervening valve is required for looped systems. Intervening valve locations will be approved by the Utilities and Environmental Services Department. Transmission line sizes will be determined on a case-by-case basis, if not already identified in the City's Water Distribution System Master Plan.

2. Three (3) inch, ten (10) inch, fourteen (14) inch, and other non-standard

pipe sizes shall not be allowed.

3. All water mains, eight (8) inches in diameter and larger, shall be profiled.

4. Water mains shall be located where maintenance can be accomplished with the least interference with traffic, structures, and utilities. Existing mains that cannot be adequately maintained must be relocated.

5. The separation between water and wastewater mains must comply with TCEQ rules or have a variance approved by the TCEQ before submittal to the City. Water mains shall be installed with a minimum of eighteen (18) inches clearance from other utility and drainage lines.

6. Standard assignment for water mains shall be one (1) foot inside the right-of-way line (or in an easement) and on the high side of a public street or private drive aisle according to natural topography unless otherwise accepted by the City. The latter requirement may be relaxed if it is demonstrated and the City agrees there is one or more compelling reasons to assign a main on the low side of a street (i.e. numerous crossings are avoidable, maintenance is facilitated, etc.)

   Unless otherwise approved by the City, mains shall be located within a public right-of-way or within a recorded easement. Main assignments in City streets must be approved by the City. Mains in county roads must also be approved by the County.

7. Water mains shall be at a maximum depth of ninety-six (96) inches to proposed grade. Water mains exceeding this depth are required to be approved by the City.

8. Minimum depth of cover over the pipe and all appurtenances shall comply with City's Standard Details. Water mains shall be kept at forty-two (42) inches cover below proposed grade in unpaved areas and a minimum of thirty (30) inches cover below sub-grade in paved areas. Water crossings under other utilities shall be prohibited, except where express consent is granted by the City. Such acceptance shall be based on detailed plans and exhibits that adequately explain and demonstrate the crossing. Steel encasement pipe shall be provided under permanent structures, such as storm water boxes, culverts, retaining walls, and any pipe thirty-six (36) inches in diameter and larger. Concrete encasement of water mains is prohibited. Concrete trench caps above bedding are generally acceptable for creek or stream crossings as proposed by the design engineer and accepted by the City on a case-by-case basis.

9. For mains twelve (12) inches and larger, drain valves shall be placed at low points, (i.e. fire hydrant or flush valves).

10. All fire sprinkler supply lines shall have a gate valve on the line at the connection to the City main line within a City easement and a backflow preventer outside of the City easement, but accessible for inspection by City personnel. All un-metered fire lines shall have a City approved flow

detection device. Sprinkler supply lines exceeding sixty-five (65) feet in length must have an approved backflow prevention device located as close to the beginning of the line as possible.

11. The design engineer is responsible for determining when air/vacuum release valves are required and the size required. On water mains twelve (12) inches in diameter and larger, automatic air release valves will be placed at all high points and at the down-slope side of all valve locations. Automatic air/vacuum and vacuum release valves shall be approved on a case-by-case basis.

12. All pipe and accessories shall be of new materials only. Water mains shall be Ductile Iron (AWWA C-110, C-104 and ANSI/AWWA C-153/A21.53-84, min. pressure Class 200) or PVC (AWWA C-900/C-905, ASTM F477 and D3139, min. pressure Class 200), or HDPE (AWWA C-906, ASTM F714, NSF 61 and PE 3408 by ASTM 3350) with a minimum 11 dimension ratio and (DR) ductile iron pipe size (DIPS). Service piping shall be copper seamless type K or polyethylene DR9 as accepted by the City. Minimum size of service lines shall be as follows:

Dwelling Units	Minimum Line Size
1	1”
2	1.5”
3-6	2”
7-11	4”
12-75	6”
More Than 75	8”

13. In residential areas, double meter services shall be provided as often as possible to minimize the number of service lines to be maintained in the future. Service lines under pavement shall be placed, according to the most current City detail.

    Commercial and industrial areas shall use separate taps for domestic and irrigation services.

14. Water mains between residential lots are prohibited. Water mains along the rear of residential lots, through back yards, are prohibited.

15. Placing water mains within State rights-of-way or within ten (10) feet of State rights-of-way shall be prohibited unless such is specifically approved by the City, provided easements are exclusive, unobstructed, and accessible.

16. Water mains, fire hydrant leads, and water meters are allowed in easements, if it can be demonstrated that the easement will be

exclusive, unobstructed, and accessible, and that the water main or fire hydrant leads will be a minimum of fifteen (15) feet from any structure. Minimum easement width shall be fifteen (15) feet and an additional two (2) feet of easement width provided for every one (1) foot of depth of cover greater than seven (7) feet. Minimum easement between residential lots shall be thirty (30) feet.

17. Meter boxes/vaults shall be reviewed and approved by the City.

18. Under no circumstances shall more than thirty (30) Home Units, Townhomes, or Condos be served by a single water main feed.

19. Wherever possible, a looped water system shall be provided and dead-end mains will be avoided. When a dead-end main containing more than 100 gallons of water is proposed, it must be approved by the City and meet the following criteria:

    A. If a dead-end section is installed and no service is to be taken from the dead-end main, an approved flushing assembly device must be installed at the terminus of the dead-end main.

    B. If a dead-end section is installed and service is to be provided via the dead-end, the water demand from the dead-end section must be sufficient to turn over the water at least every 72 hours.

    If the water demand is not sufficient to turn over the water every 72 hours, an approved flushing assembly device must be installed at the terminus of the dead end main.

20. Only one (1) fire suppression device is allowed on a dead-end water main.

21. Maximum deflection at the joint is five (5%) percent or 80% of the manufacturer's allowable deflection, whichever is less.

C. Valves and Fittings

1. All valves and fittings shall be restrained. Fittings shall be restrained and have thrust blocking.

2 There shall be a valve restrained to the main tee of each fire hydrant. These and all valves shall be resilient wedge gate valves, unless the City approves the use of butterfly valves at specific locations. In lines thirty six (36) inches and larger, butterfly valves may be used except in areas described below where resilient wedge gate valves are specifically required.

3 Valves shall be located at the intersection of two (2) or more mains and shall be spaced so that no more than thirty (30) customers will be without water during a shutdown. For lines smaller than twenty-four (24) inches, typical spacing shall be five hundred (500) linear feet in high-density areas

and twelve hundred (1,200) linear feet in a residential area, with a maximum spacing of one thousand five hundred (1,500) linear feet. For mains twenty-four (24) inches to thirty (30) inches, a valve shall be installed at intervals not to exceed two thousand (2,000) linear feet. For lines thirty-six (36) inches and larger, valve spacing shall not exceed two thousand five hundred (2,500) linear feet.

4 At dead-end water mains that will be extended in the future, gate valves shall be located one (1) pipe length, with a twenty (20) foot minimum, from the end points (restrained plug) of the main. In lines larger than sixteen (16) inches, gate valves shall be resilient wedge gate valves. The Engineer shall provide and show drawings for complete restraint for all such valves, pipe extensions and end plug.

5 Branch piping, both new and future branches shall be separated from the main with gate valves. In branches larger than sixteen (16) inches these shall be resilient wedge gate valves.

6 For mains twelve (12) inches and smaller, valves at street intersections shall be located at opposite point of curvature (p.c.) of the curb line and outside any sidewalk ramps. These valves shall be restrained to the tee/cross.

7 All valves from six (6) inches to thirty (30) inches shall be gate valves. Gate valves shall be located on each leg of a tee or cross (i.e. each tee will require three (3) gate valves and each cross will require four (4) gate valves to be installed) and restrained to the fitting. Gate valves shall not be installed within sidewalk ramps. Variations from these requirements require approval by the Director of Utilities and Environmental Services.

8 The operating nut or extension of any valve shall be between eighteen (18) inches and twenty four (24) inches below finished grade. Extensions of valve nuts shall be provided when the valve nut is greater than ninety-six (96) inches below finished grade extensions shall not be fixed to operating nut.

9 Valves with valve extensions and those at pressure zone boundaries shall be equipped with a locking type debris cap.

10 All gate valves and butterfly valves shall be installed in accordance with the City's Standard Details. Horizontal installation of gate valves is prohibited.

11 Gate valves twenty-four (24) inches and larger shall have a minimum four (4) inch by-pass piping.

12 Valve stem riser cans shall be raised above natural grade in unpaved areas and the City may require a metal sign to indicate the valve's location.

D. Fire Hydrants

1. Fire hydrants shall be placed at a maximum of five hundred (500) foot intervals along residential streets and a maximum of three hundred (300) foot intervals along all other streets. Specific fire hydrant locations subject to permit review and approval. Consideration shall be given to accessibility and functionality of position when locating fire hydrants and such consideration could shorten the above stated spacing as required by the City. Fire hydrants shall be in conformance with AWWA specifications with National Standard Threaded (NST) outlets suitable for use with City fire protection equipment.

2. If required by the City, fire hydrants shall be installed on both sides of all divided road/highways. Roads/highways where opposing lanes of traffic are separated by a vertical obstruction shall be considered a divided road/highway.

3.

3. No private fire hydrants shall be allowed.

4. The entire fire hydrant assembly shall conform to the City's Standard Details including all restrained ductile iron piping and valves.

E. Services

1. Water services shall be constructed in accordance with the City's Standard Details. More than two meters on a single service line will be considered on a case-by-case basis.

2. Individual meter services will not be taken from transmission lines. Transmission lines are generally considered to be twenty-four (24) inches in diameter or larger. Exceptions must be requested by a Professional Engineer and approved by the Utilities and Environmental Services Director.

F. Water Meters for Multi-Family and Commercial Customers

Master meters are prohibited for multi-family, manufactured home, rental community, commercial property, or any other multiple-use facility, unless otherwise approved by the City in the original development process. Each individual building must be individually metered and located in an appropriate easement to allow the City to access and work on the meter assembly. The measurement of the quantity of water, if any, consumed by the occupants of individual units shall be provided by the following:

1. Sub-meters, owned by the property owner or manager, for each dwelling unit or rental unit.

2. An alternative method approved by the City.

1.6.3 Wastewater Systems

Connection with a TCEQ approved sanitary sewer system shall be required except where the City determines that such connection would require unreasonable

expenditure of funds when compared with alternate methods of sewage disposal. Where alternate sewage disposal is permitted, the plans for such system must meet the requirements of the City, the TCEQ, and be approved by the Williamson or Travis County Health Department, whichever is appropriate, prior to approval of the final plat by the Planning and Zoning Commission.

Developers shall install all wastewater mains and lines necessary to serve each lot in an entire subdivision, addition, or site development project. The Developer shall install necessary on-site and off-site sanitary sewer mains and shall extend service to all lots, terminating each service with a cap. For the orderly extension of wastewater lines as established in the City's Water and Wastewater Master Plans, maintained by the City.

Developers shall install wastewater mains to the boundaries of their development for future connection by the development of the abutting land. Services from multi-family and non-residential lots shall connect at manholes.

The design engineer shall include a statement with the wastewater system plans that the wastewater system meets the requirements set forth herein and complies with the rules and regulations established by the TCEQ in Chapter 217 (Design Criteria for Sewage Systems) and Chapter 213 (Edwards Aquifer Rules) of the Texas Administrative Code, as amended.

A. Determination of Wastewater Flow

1. Residential single-family units (where one LUE equals one (1) single family unit or service unit) shall be assumed to produce an average wastewater flow as shown in City of Round Rock Code of Ordinances Section 44-37(a)(5) .

2. Residential multifamily units shall be assumed to produce wastewater flow based on the table shown in City of Round Rock Code of Ordinances Section 44-37(e)(2), and where one LUE is defined in City of Round Rock Code of Ordinances Section 44-37(a)(5).

2. Industrial/commercial wastewater flows will be determined by the City on a case-by-case basis in conjunction with information supplied by the design engineer.

3. Inflow and Infiltration (I/I)

   In sizing wastewater mains, external contributions are accounted for by including seven hundred fifty (750) gallons per acre per day served for inflow and infiltration. For wastewater mains in the Edwards Aquifer Recharge Zone, refer to the TCEQ requirements. Strict attention shall be given to minimizing inflow and infiltration.

4. Peak Dry Weather Flow (PDWF)

   PDWF is the peak wastewater flow from the LUEs that are contributing to the sewer system, excluding inflow from surface water or infiltration of

ground water. The PDWF is derived from the formula:

$$Q_{pdwf} = ([18 + (0.018 \times F)^{0.5}] / [4 + (0.018 \times F)^{0.5}]) \times F$$

Where: F = 80 gal./person/day x No. of LUEs x 3.5/1440 = average dry-weather flow in gpm

5. Peak Wet Weather Flow (PWWF)

The Peak Wet Weather Flow is obtained by adding inflow and infiltration to the PDWF. In designing for an existing facility, flow measurement shall be used in lieu of calculations for the pre-existing developed area.

6. Minimum Flow.

The minimum flow is derived from the formula:

$$Q_{min.} = [0.2\ (0.0144 \times F)^{0.198}] \times F$$

B. Determination of Pipe Size

1. Minimum Size.

All wastewater mains shall be installed in accordance with the City's Wastewater Master Plan. All wastewater mains shall be sized to provide necessary service to the tract to be developed. The minimum diameter of all gravity wastewater mains shall be eight (8) inches. For service line sizes, refer to the City's Standard Details. The City may require oversizing of certain mains in accordance with City ordinances.

2. Design Requirements.

a. For wastewater mains, fifteen (15) inches in diameter or smaller, use the larger pipe diameter as determined below:

i. The main shall be designed such that the PDWF shall not exceed sixty-five (65) percent of the capacity of the pipe flowing full.

ii. The main shall be designed such that the PWWF shall not exceed eighty-five (85) percent of the capacity of the pipe flowing full.

b. For sewer mains eighteen (18) inches in diameter or larger, the main shall be designed such that the PWWF shall not exceed eighty (80) percent of the capacity of the pipe flowing full. Full flow shall mean the capacity of a pipe that has a depth of flow equal to the pipe diameter, and the hydraulic grade is at the inside top of the pipe.

3. Design Velocities

The minimum design velocity calculated using the PDWF shall not be less than two (2) feet per second (fps). The maximum design velocity calculated using the PWWF shall not exceed ten (10) fps. Velocities in excess of ten (10) fps may be considered under special conditions where no other options are available. In such cases, proper consideration shall be given to pipe material, abrasive characteristics of the wastewater flows,

turbulence and displacement by erosion or shock.

4. Minimum and Maximum Slope

The minimum and maximum slope for mains within the service area of the City shall be as shown on the following table. Flatter grades may be approved on a case-by-case basis by the City.

City of Round Rock Minimum and Maximum Pipe Slopes

Size of Pipe *(inches)*	**Minimum Slope** *(%)*	**Maximum Slope** *(%)*
8	0.40	8.40
10	0.30	6.23
12	0.25	4.88
15	0.20	3.62
18	0.11	2.83
21	0.09	2.30
24	0.08	1.93
27	0.06	1.65
30	0.055	1.43
33	0.05	1.26
36	0.045	1.12
39	0.04	1.01
>39	*	*

**For pipes larger than 39 inches in diameter, the slope is determined by Manning's formula to maintain a velocity greater than 2.0 feet per second and less than 10.0 feet per second when flowing full.*

Manning's Formula

$$V = \frac{1.49}{n} \times R_n^{0.67} \times \sqrt{S}$$

Where:

V = velocity (ft. /sec)

n = Manning's roughness coefficient (0.013)

R_h = hydraulic radius (ft.)

S = Slope (ft. /ft.)

C. Design Considerations

1. Materials and Standards

All materials and appurtenances shall conform to the City standards. Gravity wastewater mains shall be eight inch (8) minimum and constructed of PVC (ASTM D3034, SDR-26), HDPE (AWWA C-906, ASTM F714, and PE 3408, 3608, or 4710 by ASTM 3350, or as amended) with a minimum 13.5 dimension ratio (DR), Ductile iron pipe size (AWWA C-110), Fiberglass (ASTM D3262), or PVC (ASTM D3212 and A2026) "double wall" or other equivalent as approved by the City. Gravity wastewater services shall be six (6) inches minimum and constructed of PVC (ASTM D 3034, SDR-26) unless otherwise accepted by the City.

2. Protecting Public Water Supply

No physical connection shall be made between a drinking water supply and a wastewater line or any appurtenance thereof. An air gap of a minimum of two inlet pipe diameters between the potable water supply and the overflow level connected to the wastewater system shall be provided.

3. Location

The location of the wastewater main shall be in conformance with the City's Standard Details. The City must approve alternative assignments. Outside the city limits, the design engineer shall coordinate utility assignments with the City and other appropriate authority.

Standard assignment for wastewater mains shall be five (5) feet off the street centerline opposite from water main, unless the City determines that an alternate location is acceptable.

Wastewater mains along the rear of residential lots, continually through back yards, between residential lots and crossing blocks shall be prohibited.

4. Separation Distance

The separation between wastewater mains and other utilities shall be in accordance with the rules and regulations adopted by the TCEQ. Wastewater mains and services shall be installed with a minimum clearance of eighteen (18) inches from water or stormwater lines.

5. Steep grades

Where the pipe grade exceeds twelve (12) percent, concrete retards conforming to the City standards will be required at intervals of no more

than twenty-five (25) feet (preferably at joint locations) around the exterior of the pipe within the bedding envelope.

6. Depth of Cover

The minimum depth of cover over the upper-most projection of the main shall comply with the City's Standard Details; the maximum depth shall be as approved by the City for the specific material, application and conditions. The design Engineer shall strive to keep wastewater mains in streets at reasonable depths, eight (8) feet from the top of the pavement to the flow line. Excessively deep wastewater mains, greater than twelve (12) feet, shall be avoided, unless otherwise accepted by the City. When wastewater mains will be more than twelve (12) feet deep from the flow line to the top of the finished surface and services to the main are required, an alternate method of intercepting services or alternate service design shall be provided. For example, a parallel line that is laid at a shallower depth might be designed to pick up services and the line tied to the deep main at one (1) or more practical locations. Steel encasement pipe shall be provided under permanent structures. Concrete encasement of wastewater lines is prohibited.

7. Easements

Excessive depths of mains in easements shall be avoided. Easements shall be a minimum of fifteen (15) feet in width with an additional two (2) feet of easement width for every one (1) foot of depth over eight (8) feet. Utility or easement lots may be appropriate in some cases.

8. Turbulence

Wastewater lines and manholes shall be designed to minimize turbulent flow to prevent release of sulfide gases.

D. Manholes

1. Manholes shall be located and spaced so as to facilitate inspection and maintenance of the wastewater main. Manholes shall be placed at the following locations:

   a. Intersections of mains.

   b. Horizontal alignment changes.

   c. Vertical grade changes.

   d. Change of pipe size.

   e. Change of pipe material.

   f. The point of discharge of a force main into a gravity wastewater main.

   g. Intersection of service lines to main lines twenty-four (24) inches and larger.

   h. At the point of connection of a building service line to the wastewater

main for multi-family projects and for other non-residential developments.

2. Manholes shall be reinforced concrete and conform to the City's Standard Details.

3. Connections to existing manholes shall be made by coring and conform to the City's Standard Details. Cored manholes shall be lined according to City's standard details and using the same lining material that existed prior to the coring.

4. Manhole spacing for lines smaller than twenty-four (24) inches shall not exceed four hundred (400) feet; for larger mains, spacing may be increased, subject to approval by the City.

5. All manholes not located in paved areas shall have watertight covers bolted in place with signage indicating the manhole's location. Manholes shall be raised from two (2) to twelve (12) inches above final grade depending on field conditions.

6. Manholes shall be constructed of or lined with a corrosion resistant material. Where new construction ties into an existing manhole, the existing manholes must be lined, coated, or replaced with a corrosion resistant material. If the existing manhole is in poor condition, the manhole must be repaired or replaced prior to lining or coating.

7. All lines into manholes, including drop connections, shall match crown-to-crown

8. Drop manholes will have a maximum of eight (8) foot of drop and require City approval where the main size exceeds fifteen (15) inches. All internal drops shall be approved by the City on a case by case basis.

9. Manholes shall have the following minimum sizing:

   a. Forty-eight (48) inches for mains eighteen (18 inches in diameter or smaller.

   b. Sixty (60) inches for mains larger than eighteen (18) inches and smaller than thirty (30) inches in diameter.

   c. Seventy-two (72) inches for thirty (30) inches in diameter to smaller than forty-eight (48) inches in diameter.

   d. Eighty-four (84) inches diameter for mains forty-eight (48) inches and larger.

E. Ventilation

Ventilation shall be provided as required by TCEQ rules and regulations.

F. Inverted Siphons

Inverted siphons must be approved by the Utility Director prior to construction. Siphons shall have a minimum of two barrels. The minimum pipe size shall be

six (6) inches with a minimum flow velocity of three (3) fps at peak dry weather flow. The minimum dry weather flow shall be used to size the smallest barrel. Three-barrel siphons shall be designed to carry the capacity of the incoming gravity wastewater mains(s) with one barrel out of service.

An additional corrosion resistant pipe shall be designed to allow for the free flow of air between the inlet and outlet siphon boxes. The diameter of this air jumper shall not be smaller than one-half the diameter of the upstream sewer. Air jumper pipe design shall provide for removal of condensate water that will collect in the pipe.

Siphon inlet and outlet structures shall be manufactured with approved corrosion resistant material including all metal parts including pipe brackets and bolts must be a minimum Grade 316 stainless steel and shall provide for siphon cleaning and maintenance requirements.

G. Service Lines

Wastewater service lines, between the main and property line, shall have an inside diameter not less than six (6) inches. The minimum grade allowed for service lines is one (1) percent. Service connections made to mains larger than fifteen (15) inches in diameter shall be considered on a case-by-case basis. Services into the top of mains, stack-type, shall be prohibited. Services shall be laid on straight grade from main to point of termination, without horizontal or vertical bends, unless otherwise approved by the City.

Wastewater services are generally placed along the common property line between two lots where there is no conflict with other utilities' services or curb inlets. Domestic water service is generally located at the other lot corner. Wastewater service shall be placed two (2) feet on the right of the common lot line. Dry utilities are placed two (2) feet left of the common lot line. Services to lots without a water/wastewater easement may terminate at the property line with a clean-out; service to lots having a five foot by five foot (5’ x 5’) water/wastewater easement may terminate within the easement. For details, see the City’s Standard Details.

Single-family and duplex service connections shall be made with sanitary sweep tees at a ninety (90) degree intersection with mains. Commercial, multi-family, and industrial services shall intersect the City system at a manhole.

H. Lift Stations Design Criteria (Excluding Low Pressure Systems)

1. Engineering Report, Plans, and Specifications Review and Acceptance

Acceptance of plans shall expire two (2) years from the date of acceptance. If construction has not commenced on the facility within two (2) years of the acceptance date, plans must be resubmitted for acceptance and must include and comply with all design and construction criteria in effect at the time resubmitted.

Prior to design, three (3) copies of a detailed engineering report shall be

submitted to the City for review and approval of the lift station and all related line work. The engineering report shall include the following:

a. Justification for the proposed lift station. The report must clearly show that gravity lines are not available or are not economically feasible and that the number of lift stations has been minimized. This justification must include a cost benefit analysis of gravity versus lift station project including thirty (30) years of operation and maintenance of the proposed system.

b. A master development plan for the service area of the proposed lift station shall be prepared. This plan shall include a map showing the location of the lift station, the service area topographic information with two feet contours, the boundaries of the drainage basin, and the location of the nearest existing wastewater interceptor within that basin.

c. Engineering calculations and data described in Sections 1.6.3.A. and 1.6.3.H. shall be contained in the engineering report.

d. The City must approve the Engineering Report prior to the developer beginning preparation of the plans and specifications.

f. TCEQ approval of the lift station is required prior to City approval.

2. All plans and specifications for lift stations within the City's ETJ, submitted for review and acceptance, must demonstrate compliance with current City Water and Wastewater Utility Design Criteria and standard lift station specifications.

The following type of lift stations shall be submitted for review and acceptance:

a. Submersible or grinder pump facilities with rated horsepower no greater than twenty-five (25) Brake Horse Power (BHP) for the largest pump.

b. For installation with a required rated horsepower motor greater than twenty- five (25) BHP the City prefers wet/dry well type installation. However, submersible non-clog pump facilities with a rated horsepower of between twenty-five (25) BHP and fifty (50) BHP may be considered on a case-by-case basis. The Engineer must submit cost comparisons for submersible versus wet/dry well installations. The cost comparison shall include initial station costs, pump replacement costs, installation costs and all operational and maintenance cost including energy costs over the life of the station. The comparison shall assume a typical service life for submersible pumps.

Acceptance of the lift station plans and specification does not imply

the City will accept the lift station for operation and maintenance (Refer to 1.5.3.).

3. Submittal and Shop Drawing Review

Once the engineering report, plans and specifications have been accepted, at least three (3) complete sets of submittals and construction plans shall be provided to the City. These submittals shall contain complete detailed information and drawings for all lift station equipment and components.

4. City Operation and Maintenance Acceptance

The City may accept a lift station with a firm pumping capacity greater than twenty-five (25) gallons per minute (gpm) for operation and maintenance provided the following conditions are met:

a. The station is located within the City's approved wastewater service area and wastewater impact fees are collected for the area served by the lift station area.

b. The lift station has been inspected and determined to be constructed in conformance with the City and TECQ requirements. Any lift station not conforming to City standards shall be upgraded to City standards before the City will accept the lift station for operation and maintenance.

c. The owner or his representative must provide five (5) complete sets of all final Operations and maintenance (O&M) Manuals for all equipment installed with the lift station, and has received City acceptance. The O&M Manuals shall describe the general operations of the equipment and provide information on the proper maintenance procedures to be performed on the equipment.

d. The owner has granted the City a wastewater easement for the lift station and all-weather access road. A copy of the recorded easement plat, legal description and any other legal documents granting the easement shall be delivered to the City. The easement shall extend to at least five feet outside the lift station fence and shall include an all-weather access road with turn-around areas that extend back to paved public right-of-way. This easement shall be separate and in addition to any necessary pipeline easement.

   If the lift station is to become a permanent installation, transfer of ownership and title to the land may be required by the City prior to acceptance of the station for operation and maintenance.

e. Additionally, a letter of assignment shall be written to the City from the owner transferring title of the lift station and related equipment to the City. This letter shall be delivered to the City before

acceptance of the lift station for operation and maintenance. The original owner may regain title to a temporary lift station that was designed and constructed entirely at his expense and for which no refund was made by the City. After written notification by the City that the lift station has been abandoned, the original owner has one (1) month to notify the City in writing of his intent to regain title to the lift station.

f. One (1) complete set of as-built drawings and a copy of the file in electronic format as specified by the City shall also be provided to the City prior to acceptance of the lift station for operation and maintenance.

Lift stations will be allowed only where conventional gravity service is not feasible. The City may impose additional requirements for individual lift stations as conditions warrant. Wastewater service facilities within a site or subdivision shall be designed so as to minimize the number of lift stations needed to serve the lots.

In addition to these criteria, all lift stations must meet the TCEQ Chapter 217 rules as amended and the provisions of this Manual.

5. Flow Development

Calculation of wastewater flow shall be done in accordance with Section 1.6.3.A. The following calculations shall be included:

a. Maximum Wet Weather Flow (Design Flow)

This flow is used to determine the lift station design capacity. All lift stations shall be designed to handle the maximum wet weather flow for its service area.

<u>Equation:</u> (Population of service area x 80 gallons per capita per day (gpcd) x maximum flow peaking factor) + (750 gallons per acre served)

b. Maximum Dry Weather Flow

This flow is used to determine pipe size in the collection system.

<u>Equation:</u> (Population of service area) x (80 gpcd) x (maximum flow peaking factor)

c. Average Dry Weather Flow

This is the flow developed without the maximum flow peaking factor. This flow is used to determine the average detention time in the wet well.

<u>Equation:</u> (Population of service area) x (80 gpcd)

d. Minimum Dry Weather Flow

This is used to determine the maximum detention time in the wet well.

Equation: (Population of service area) x (80 gpcd) x (minimum flow peaking factor)

e. A minimum of two (2) pumps shall be required for all lift station. The capacity of the pumps shall be such that the maximum wet weather flow can be handled with the largest pump out of service.

6. Wet Well Design

a. The bottom of the wet well shall have a minimum slope to the intake of two (2) vertical to one (1) horizontal. There shall be no projections in the wet well, which would allow deposition of solids.

b. The wet well volume shall be sized to provide adequate storage volume at peak design flows and a pump cycle time of sufficient duration to prevent pump short cycling and consequential motor damage. Pump cycle time, defined as the sum of "pump off" time plus "pump on" time, shall be as follows:

Motor Horse Power	Minimum Cycle Time In Minutes (θ)
2 to 50	10
51 to 75	15
76 to 250	30
251 to 1500	45

Volume between "pump on" and "pump off" elevation (of the pump cycle) shall be determined by the following criteria:

$$V = \theta q/4$$

where q = pump capacity in gpm and θ is the minimum cycle time in minutes.

c. All "pump on" levels shall have a minimum separation of one (1) foot between levels. All "pump off" levels shall be at least six (6) inches above the top of the pump casing. For more than two (2) pumps, the "pump off" levels shall be staged with a minimum separation of one (1) foot between levels.

d. An example of a two (2) pump staging sequence follows:

High-level alarm

Lag pump on

Lead pump on

Lag pump off

Lead pump off

Low-level alarm

The high level alarm shall be at least one foot above the last (highest) "pump on" level in the wet well and also at least one (1) foot below the flow line of the lowest influent line into the wet well.

For lift stations with three (3) pumps or more, the following method for calculating the wet well volume may be used:

$V = 2 \times q_1/4$ and $K = (q_1 - q_2) + q_1$

$V_2 = V' \times N \times V_1$

Where: V_1 = working volume for the first pump in gallons

θ = minimum cycle time in minutes

q_1 = capacity of the first pump in gpm

q_2 = capacity of the second pump in gpm

K = the ratio of the discharge increment to the discharge of the first pump, without dimensions

V_2 = working volume for the second pump in gallons

V' = the ratio of additional draw down volume to the volume for one pump without dimensions

N = number of pumps

1) Calculate V_1 and K.
2) Locate K on Table 1 and read the corresponding value for V'.
3) Calculate V_2.

e. An example of a three (3) pump starting sequence is as follows:

High-level alarm

Third pump on

Second pump on

First pump on

Third pump off

Second pump off

First pump off

Low Level alarm

For the location of the high level alarm, refer to the example of a two pump starting sequence.

f. Adequate space shall be provided between the bottom of the wet well at the intake of the pumps.

TABLE 1: V' Values Corresponding To Various Values

K	V’	K	V’	K	V’
0.00	0.00	2.10	1.36	3.49	2.63
0.33	0.00	2.13	1.39	3.53	2.67
0.44	0.01	2.17	1.42	3.57	1.70
0.53	0.04	2.20	1.45	3.61	2.74
0.62	0.08	2.23	1.49	3.65	2.77
0.70	0.12	2.27	1.52	3.69	2.81
0.77	0.16	2.30	1.55	3.73	2.85
0.84	0.21	2.34	1.58	3.77	2.88
0.90	0.25	2.37	1.62	3.81	2.92
0.96	0.29	2.41	1.65	3.85	2.96
1.02	0.34	2.45	1.68	3.89	3.00
1.07	0.38	2.48	1.71	3.93	3.03
1.12	0.42	2.52	1.75	3.97	3.07
1.17	0.46	2.55	1.78	4.01	3.11
1.22	0.51	2.59	1.81	4.05	3.15
1.26	0.55	2.62	1.84	4.09	3.18
1.30	0.59	2.66	1.88	4.13	3.22
1.34	0.63	2.70	1.91	4.17	3.26
1.38	0.66	2.73	1.94	4.21	3.30
1.42	0.70	2.77	1.97	4.25	3.34
1.46	0.74	2.81	2.01	4.29	3.38
1.50	0.78	2.84	2.04	4.33	3.42
1.54	0.81	2.88	2.07	4.38	3.45

1.57	0.85	2.92	2.11	4.42	3.49
1.61	0.89	2.95	2.14	4.46	3.53
1.65	0.92	2.99	2.18	4.50	3.57
1.68	0.96	3.03	2.21	4.54	3.61
1.72	0.99	3.07	2.24	4.58	3.65
1.75	1.03	3.10	2.28	4.63	3.69
1.79	1.06	3.14	2.31	4.67	3.73
1.82	1.09	3.18	2.35	4.71	3.77
1.86	1.13	3.22	2.38	4.75	3.81
1.89	1.16	3.26	2.42	4.79	3.85
1.92	1.19	3.29	2.45	4.84	3.89
1.96	1.23	3.33	2.49	4.88	3.93
1.99	1.26	3.37	2.52	4.92	3.97
2.03	1.29	3.41	2.56	4.96	4.01
2.06	1.33	3.45	2.59	5.01	4.05

K = Pump discharge (Dimensionless) V' = Volume (Dimensionless)

Source: ALBERT PINCINE

7. Wet Well Detention Time

a. Calculate the detention time (T_d) in the wet well for the maximum wet weather flow, maximum dry weather flow and average dry weather flow using the following equation:

$$T_d = t_f + t_e$$

Where:

t_f = (v) ÷ (i) = time to fill the wet well in minutes

t_e = (v) ÷ (q - i) = time to empty the wet well in minutes

V = Volume of wet well between "pump on" and "pump off" elevations in gallons

q = Pump capacity in gpm

i = flow into the station corresponding to the maximum wet weather flow maximum dry weather flow or average dry

weather flow in gpm

b. Maximum detention time shall be calculated with i = minimum dry weather flow.

c. Odor control shall be provided for the wet well, if the total detention time in the wet well and force main system exceeds 180 minutes.

8. Static Head

The static head shall be calculated for "pump on" and "pump off" elevations in the wet well.

9. Net Positive Suction Head

The Net Positive Suction Head (NPSH) required by the pump selected shall be compared with the NPSH available in the system at the eye of the impeller. The engineer shall consult the pump manufacturer for the NPSH required values for that pump and compare them with calculated values for the NPSH available. The NPSH available shall be greater than the NPSH required for a flooded suction pump. The following equation may be used for calculating the NPSH available:

$$NPSH_A = P_B + H_S - P_V - H_{fs}$$

Where:

P_B = barometric pressure in feet absolute,

H_S = minimum static suction head in feet,

P_V = vapor pressure of liquid in feet absolute,

H_{fs} = friction loss in suction in feet.

For lift stations in Round Rock's service area a barometric pressure of thirty-three and four tenths (33.4) feet may be used and a vapor pressure of one and four-tenths (1.4) feet may be used. These values are based on the following assumptions: an altitude of five hundred (500) feet above sea level, a water temperature of 85ºF and a specific gravity of water of 0.996 at 85ºF.

10. Suction Piping Design

a. All suction piping shall be flanged ductile iron and have a minimum diameter of four (4) inches. Each pump shall have a separate suction pipe.

b. Suction piping shall have a velocity of three (3) to five (5) fps.

c. All suction pipes inside the wet well shall be equipped with a flare type, down-turned intake. The distance between the bottom of the flare and the floor of the wet well shall be between D/3 and D/2 where D is the diameter of the flare inlet.

11. Force Main Design

a. All force mains shall be HDPE DR13.5 with a minimum diameter of four inches. Force main pipe within the station shall be flanged. Flexible fittings shall be provided at the exit wall.

b. Force mains shall be sized so that the flow velocity is between three (3) and six (6) feet per second at ultimate development. During initial development phases, flow velocities may be as low as two and one half (2.5) feet per second.

c. The maximum time required to flush the force main shall be calculated on the basis of average dry weather flow. Flush time shall be calculated for average dry weather flow using the following equations:

*See Section 1.8.3.H.3.a, "Wet Well Detention Time", for an explanation of V and q.

d. Odor and corrosion control shall be provided for the force main if the force main detention time exceeds thirty (30) minutes.

e. The design engineer shall evaluate location and size of all air release valves for odor or nuisance potential to adjacent property. The use of air release valves shall be restricted to installations where there are no possible alternatives.

f. Lift station/force main systems shall be evaluated for their sulfide generation potential and their ability to achieve scouring velocities during average dry weather flow periods. If the evaluation indicates that sulfide concentration of greater than two (2) ppm and solids deposition are likely, the design shall:

1) define a workable sulfide control technique that will minimize sulfide formation in the force main;

2) include "pig" launching stations and recovery points to allow cleaning of the force main; and

3) protect the gravity main and manholes downstream of the force main from corrosion. The length of pipe to be protected shall be determined on a case-by-case basis.

g. The force main shall discharge into its own distinct manhole. (i.e. multiple force mains shall not discharge into a single manhole.) Force mains going into existing manholes require approved lining of the manhole per City standard details prior to placing the force main into service.

h. Thrust restraint when required shall be shown on the plan view.

12. Head Loss Curves

a. Data points for the system capacity curve shall be provided in tabular

form and graphed with pump head capacity curve on the same graph. Two (2) system capacity curves shall be plotted using the Hazen Williams coefficient values of C = 100 and C= 120.

b. Pump output in gpm at maximum and minimum head shall be clearly shown on the system curve for each pump and combination of pumps.

c. For stations with two (2) or more pumps operating in parallel, multiple and single operation points shall be plotted on the system curve.

d. Pumps with the highest efficiencies at all operating points shall be used.

e. If pumps are equipped with smaller impellers during start up to handle lower than design flows, impellers sized to handle the design flow shall also be provided.

13. Buoyancy Calculations

The lift station design shall include a complete analysis of buoyant forces on the entire lift station structure.

14. Water Hammer

a. Calculations for water hammer showing maximum pressures, which would occur upon total power failure while pumping, shall be provided using the following equations:

$p = (a)(V) / (2.31)(g) + \text{operating pressure of pipe (psi)}$

$a = 12 \div \{(w/g)[(1/k) + (d/Et)]\}^{0.5}$

Where:

p = water hammer pressure (psi)

a = pressure wave velocity (ft/s)

w = specific weight of water (62.4 lb/ft^3)

g = acceleration of gravity (32.2 ft/s^2)

k = bulk modulus of water (300,000 psi)

d = inside diameter of pipe (in)

E = Young's modulus of pipe (psi)

t = pipe wall thickness (in)

v = flow velocity in pipe (ft/s)

Surge control measures shall be provided when pressures, including those due to water hammer, exceed the pressure rating of the pipe.

15. Suction Specific Speed

Suction specific speed of the pumps shall be calculated using the following formula:

$$SSS = \Sigma(Q)^{5} / (H)^{75}$$

Where: SSS = Suction specific speed (rpm)

Q = flow at best efficiency point, gallons per minute (gpm)

H = net positive suction head required at maximum impeller speed, in feet

Σ = speed of pump and motor, in revolutions per minute (rpm)

Suction specific speed shall be below 9,000 rpm to ensure that the pump would not cavitate because of internal recirculation.

16. Stiffness Ratio

In order to ensure that the pump shaft does not bend an excessive amount, the engineer shall calculate the stiffness ratio of the shaft using the following equation:

$$\text{Stiffness Ratio} = L^3/D^4$$

Where:

L = distance from impeller centerline to the centerline of the inboard bearing, in inches

bearing, in inches

D = diameter of shaft (inches)

The stiffness ratio shall not exceed sixty (60).

17. Energy Calculations

For lift stations with flows exceeding seventy five (75) gpm but less than one thousand (1,000) gpm, and if the engineer is considering a submersible type lift station as an option then the engineer shall submit cost comparisons for submersible stations versus wet well/dry well stations. These cost comparisons shall include the initial station costs, installation costs and power costs for the life of the station.

Energy costs for each type station shall be calculated using the following equations:

a. Calculate the water horsepower required.

$$WP = (Q)\,(h)\,(8.34 \text{ lbs./gal}) / 33{,}000 \text{ ft-lb min/hp}$$

Where:

WP = water horsepower (hp)

Q = flow, gallons per minute (gpm)

h = head, feet (ft)

b. Calculate the brake horsepower required.

$$BHP = WP / \text{pump efficiency*}$$

Where:

BHP = brake horsepower (hp)

WP = water horsepower (hp)

* Use the most efficient pumps for the application.

c. Calculate the electrical horsepower required

$$EHP = BHP / \text{motor efficiency}$$

Where:

EHP = electrical horsepower (hp)

BHP = brake horsepower (hp)

*Use the most efficient motors for the application.

d. Calculate the power required in kilowatts.

$$EKW = (EHP)\ (0.746\ Kw/hp)$$

e. Calculate daily power consumption in kilowatt-hours.

$$E = [(EKW_1)\ (t_1) + (EKW_2)\ (t_2) + (E\ KW_3)\ (t_3)...]$$

Where:

E = total power consumption, kilowatt hours (kWh) per day

EKW_n = power required, kilowatts for pumps 1, 2,..., n

t_n = estimated pump run time in hours per day for pumps 1, 2, …, n

f. Calculate the estimated cost for power consumption over the life of the station.

$$C = (E)\ (\$0.012/kWh)\ (T)$$

Where:

C = cost of power over the life of the station (dollars)

E = power consumption (kilowatt-hour per day - kWh/day)

T = time the station is expected to be in service (days)

g. Stress and thrust calculations for internal station piping and bends shall be provided for stations with flows over one thousand (1,000) gpm.

18. Sump Design

The following items apply for lift station dry well sump pumps:

a. Dual submersible sump pumps, each with a minimum capacity of one thousand (1,000) gallons per hour (gph), shall be provided.

b. The design head of the sump pumps shall be the static head from the sump to one (1) foot above the one hundred (100) year flood level plus allowances for pipe friction both inside and outside the pump chamber.

c. Sump piping shall be galvanized steel with a minimum diameter of two (2) inches.

d. Sump discharge from the dry well shall be installed through the wall of the wet well at a point not less than twelve (12) inches above the top of the influent pipe and grouted in place with a water tight seal.

e. The dry well floor shall slope toward the sump pit.

19. Specific Station Requirements

a. All stations will be required to have an equipment-lifting device.

b. Engineering calculations are required showing that temperatures inside the dry well do not exceed 85°F, while the pumps are operating.

c. Stations with motors greater than one hundred (100) hp shall use a horizontal pump/motor configuration.

d. Stations with motors that are seventy-five (75) hp and larger shall have reduced voltage starters of the autotransformer or solid-state soft start type. Part winding starters and motors are not acceptable. Motors larger than seventy-five (75) hp shall be designed with a maximum temperature rise not to exceed 80°C over a 40°C ambient temperature. Motors larger than three hundred (300) hp may require a higher temperature rise and may be specifically approved with such.

e. Motors seventy-five (75) hp and smaller shall be provided with high efficiency frames. Maximum temperature rise shall not exceed 90°C over a 40°C ambient temperature.

f. Stations deeper than thirty (30) feet, measured from the finished floor to the top of the entrance tube, shall require an electrically powered personnel lift.

g. Entrance hatches larger than forty (40) inches in diameter shall be spring- loaded.

h. Valves higher than six (6) feet above the floor shall have chain operators.

i. Any potable water supply below the overflow elevation of the wet well shall be protected by an air gap.

j. All lift stations must have a back-up power source. Looped service from two (2) different substations is adequate backup power. If a back-up electric system is not feasible, a diesel generator may be located on

the lift station site instead. Generator shall be equipped with noise and air pollution control devices.

k. Flow monitoring will be provided for all lift stations.

12. Exceptions

Exceptions to these design criteria must be requested in writing. Written approval from the Director of Utilities and Environmental Services must be obtained before any exceptions will be allowed.

I. Alternate Wastewater Systems

1. General

Low-pressure wastewater systems are discouraged and will be allowed only where conventional gravity service is not possible. For the purpose of these criteria, low-pressure sewer service is defined as private grinder pump facilities or private septic tank effluent pump facilities that do not convert to gravity flow at or prior to the property line. There shall be no more than one grinder pump facility per single family or duplex residential lot. Each grinder pump shall discharge to a gravity flow system. Grinder pump facilities for commercial establishments, Public Utility Districts (PUD) or condominiums will be considered on a case-by-case basis.

The distance for each grinder pump from the property line to the gravity main shall not exceed two hundred (200) feet.

Flows may be calculated using the Lift Stations Design Criteria provided in Section 1.8.3.H. above disregarding the Infiltration/Inflow flow component.

If the above criteria are applicable and a low-pressure wastewater service is necessary, The City will be responsible for maintaining the portion within the right-of-way only.

Design and installation of the property owner's pumping system, as well as all associated plumbing shall be reviewed, approved and inspected by the City. The system shall be designed as a complete system including all connections, pumps, etc. for lots being served by the system. If the above criteria are not applicable, refer to Lift Stations Design Criteria, Section 1.8.3.H.

2. Connection to Gravity Main

Each grinder pump facility shall be individually tied into a manhole on an existing gravity main. If a manhole does not exist, one shall be constructed. Construction costs and all other associated costs shall be the responsibility of the property owner.

The connection to the gravity main shall be designed to minimize turbulence and the release of hydrogen sulfide. The discharge point shall be at or below the spring line of the gravity main.

3. Clean-out and Valve Assemblies

A clean-out and corrosion resistant eccentric plug valve shall be placed just inside of the right-of-way where City maintenance begins and private maintenance ends. This clean-out will allow the property owner's system to be isolated and the City's portion of the system to be pressurized, flushed or rodded.

Clean-outs and corrosion resistant eccentric plug valves shall also be installed at bends of 45° degrees and greater. Refer to applicable City Standard Detail(s).

4. Separation Requirements

The separation between low-pressure sewer lines and waterlines shall comply with the TCEQ rules and regulations, City's DACS - Standard Specifications Manual and all other applicable rules and regulations.

1.6.4. Reuse Water Systems

Any reuse water distribution system connecting to the City's reuse water distribution system, whether public or private, shall be designed and constructed in accordance to the standards and specifications, herein.

If determined by the City that the development is suitable for reuse water then, the developer shall provide all reuse water lines necessary to properly serve the project, and insure that existing and/or new reuse water facilities can supply the required demand. The developer shall install all necessary on-site and off-site mains and shall extend service to all lots terminating with a meter stop and meter box. For the orderly extension of reuse water lines as established in the Reuse Water Master Plan, the developer shall install reuse water mains to the boundaries of his development of the abutting land. The developer shall submit a letter certifying and sealed by a Professional Engineer licensed by the State of Texas that the system has been designed in accordance with the requirements of this section and conform to the rules, regulations, and requirements established by the TCEQ Design Criteria in the Texas Administrative Code, as amended.

A. Mains

Sizing of Reuse Water Mains

All reuse water mains shall be installed in accordance with the Reuse Water Master Plan maintained by the City. Computer modeling is preferred for sizing reuse water mains. However, for reuse water mains less than sixteen (16) inches in diameter other engineering calculation methods may be accepted. The largest size, as determined by comparing the service area's peak hour demand and peak day shall be used. All reuse water mains shall be sized to provide necessary service to the tract being developed. The City may require oversizing of certain mains in accordance with City ordinances.

1. Minimum public main size shall be eight (8) inches unless the City approves a smaller size because of unique circumstances. The minimum size for any street type, however, will be governed by various factors which include high density land usage, and the designer's consideration of general system gridding, future mains, neighboring developments and area configuration. Looped systems are not required at this time. Main sizes will be as shown in the Reuse Water System Master Plan or determined on a case-by-case basis and approved by the City.

2. Three (3) inch, ten (10) inch, fourteen (14) inch, and other non-standard pipe sizes shall not be allowed in typical construction.

3. If the maximum static pressure exceeds eighty (80) psi, a PRV will be required on the owner's side of the reuse water meter and shall be shown on the plan view.

4. The maximum allowable velocity shall not exceed six and one half (6.5) feet per second (fps).

5. All reuse water mains shall be profiled in the construction drawings.

6. Reuse water mains shall be located where maintenance can be accomplished with the least interference with traffic, structures, and utilities.

7. The separation between reuse water, water and wastewater mains must comply with TCEQ rules or have a variance approved by the TCEQ before submittal to the City. Reuse water mains shall be installed with a minimum of eighteen (18) inches clearance from other utility and drainage lines.

8. The standard assignment for reuse water mains shall be on a case-by-case basis being a minimum of four (4') feet horizontally and two (2') feet vertically from the potable water line. Reuse water mains shall be on public property or within a dedicated easement generally toward the high side of the street according to natural topography unless otherwise accepted by the City. The latter requirement may be relaxed if it is demonstrated there is one or more compelling reasons to assign a main on the low side of a street (i.e. numerous crossings are avoidable, maintenance is facilitated, etc.)

   When reuse water mains are located outside of the right-of-way, they shall be within a recorded City of Round Rock utility easement. Main assignments in City streets must be approved by the City. Mains in county roads must also be approved by the County Engineer.

9. Piping materials and appurtenances shall conform to the City's DACS - Standard Specifications Manual.

10. Minimum depth of cover over the uppermost projection of the pipe and all appurtenances shall comply with City's Standard Details; maximum depth

will be as approved by the City for the specific materials, application and conditions. Reuse water mains shall be kept at reasonable depths three and one half foot (3.5) to four foot (4) in diameter and larger, automatic air release valves will be placed at all high points and at the down-slope side of all valve locations. Automatic air/vacuum and vacuum release valves shall be approved on a case-by-case basis.

11. For mains sixteen (16) inches and larger, drain valves may be required at low points.

12. The design engineer is responsible for determining when air/vacuum release valves are required. On reuse water mains sixteen (16) inches in diameter and larger, automatic air release valves will be placed at all high points and at the down-slope side of all valve locations. Automatic air/vacuum and vacuum release valves shall be approved on a case-by-case basis.

13. All pipe and accessories shall be of new materials only. Reuse water mains shall be Ductile Iron (AWWA C-110, C-104 ANSI/AWWA C-153/A21.53-84, min. pressure Class 150) or PVC (AWWA C-900, ASTM F477 and D3139, min. pressure Class 150), or HDPE (AWWA C-906, ASTM F714, and PE 3408 by ASTM 3350) with a minimum 13.5 dimension ratio (DR).

14. All reuse water valves to be restrained. All reuse water fittings to be restrained and have thrust blocking.

B. Reuse Water Services

1. Reuse water services shall be constructed in accordance with the City's Standard Details. More than two meters on a single service line will be considered on a case-by-case basis.

2. Individual meter services will not be taken from transmission lines. Transmission lines are generally considered to be twenty-four (24) inches in diameter or larger. Exceptions must be approved by City at the time of plan submittal. The Professional Engineer shall submit a letter with this request.

   Service piping shall be polyethylene as accepted by the City. All reuse water piping including services shall be purple or purple wrapped. Minimum size of service lines shall be as follows:

Parcel Acreage	Minimum Line Size
1/3 - 1	1"
1-2	1.5"
3-6	2"

7-11	4”
12-75	6”
More Than 75	8”

3. Service lines under pavement shall be placed in an encasement pipe.
4. Reuse water mains between residential lots, crossing blocks, shall be avoided. Reuse water mains along the rear of residential lots, through back yards, shall be prohibited. Utility or easement lots may be appropriate in some cases.
5. Constructing reuse water mains within state rights-of-way shall be prohibited unless approval is obtained from the City. Reuse water lines in easements abutting the state right-of-way are allowed provided easements are unobstructed and accessible.
6. Reuse water mains in easements will be allowed, if it can be demonstrated that the easement will be unobstructed and accessible, and that the reuse water main will be a minimum of fifteen (15) feet from any structure. Minimum easement width shall be fifteen (15) feet and an additional two (2) feet of easement width provided for every one (1) foot of depth of cover greater than seven (7) feet. Minimum easement between residential lots shall be thirty (30) feet.
7. Meter boxes and vaults shall be purple and have purple lids and signage per City Standard Details.
8. All reuse water service lines shall have a gate valve on the line at the connection to the main line and a backflow preventer inside the property line, but accessible for inspection by the City. All un-metered reuse water service shall have a City approved flow detection device.

C. Valves

1. All valves shall be resilient wedge gate valves. In lines thirty six (36) inches and larger, butterfly valves may be used except in areas described below where resilient wedge gate valves are specifically required. All reuse valves shall be reverse threaded such that they open by turning clockwise, and close turning counter-clockwise.
2. Valves shall be located at the intersection of two (2) or more mains and shall be spaced so that no more than 1,000 feet of reuse water line in commercial, industrial, or multi-family residential is without water during a shutout. Valves shall be located at the intersection of two (2) or more mains and shall be spaced so that no more than 2,000 feet of reuse water line in off-site transmission mains, and in residential subdivisions is without water during a shutout.
3. At dead ends, gate valves shall be located one (1) pipe length, with an

eighteen (18) to twenty (20) foot minimum, from the end point of the main. In lines larger than sixteen (16) inches, these shall be double disc gate valves. The Engineer shall provide and show drawings for complete restraint for all such valves, pipe extensions and end caps.

4. Branch piping, both new and future branches shall be separated from the main with gate valves. In branches larger than sixteen (16) inches these shall be resilient wedge valves.

5. For mains twelve (12) inches and smaller, valves at street intersections shall be located at opposite point of curvature (p.c.) of the curb line.

6. All valves from six (6) inches to twenty four (24) inches shall be gate valves. Gate valves shall be located on each side of a tee or cross (i.e. each tee will require three (3) gate valves and each cross will require four (4) gate valves to be installed). Gate valves to be restrained to the tee or cross fitting. Variations from these requirements require approval by the City.

8. The operating nut of any valve shall be between eighteen (18) inches and thirty (30) inches below finished grade. Extensions of valve nuts shall be provided for valve operating nuts ninety-six (96) inches below finished grade. Extensions shall not be fixed to operating nut.

9. Valves with valve extensions and those at pressure zone boundaries shall be equipped with a locking type debris cap.

10. All gate valves and butterfly valves shall be installed in accordance with the City's Standard Details.