WATER AND WASTEWATER DESIGN MANUAL

2010

City of McKinney
Engineering Department
www.mckinneytexas.org

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EFFECTIVE DATE

The following are the effective date(s) of the City of McKinney Water & Wastewater Design Manual and all of its amendments:

Edition Number	Description	Rec. by City Sec.	Effective Date
1	Complete Update to the 2002 Water and Wastewater Design Manual	11/1/10	12/1/10

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SECTION 1 INTRODUCTION

1.1 Purpose and Scope

The purpose of this manual is to establish standard principles and practices for the design and construction of water and wastewater facilities to be maintained by the City of McKinney. These rules and regulations are the standard requirements of the City of McKinney, Texas. The Water and Wastewater Design Manual is a source for standards, criteria, and specifications related to water and wastewater facilities within the City of McKinney and its ETJ.

1.2 Effective Date

The authority for this design manual is provided to the City Engineer through Ordinance 2008-08-077. This ordinance authorizes the City Engineer to promulgate rules, regulations, standards, and specifications for water/wastewater facilities and other public improvements. The effective date of the regulatory documentation is 30 days after being filed with the City Secretary.

This design manual was filed with the City Secretary on November 1, 2010; therefore, the effective date is December 1, 2010.

1.3 Appeal Process

Deviation from the requirements of this manual may be granted by the Director of Engineering. An owner / developer / applicant who wishes to appeal to the Director of Engineering regarding the design of water and/or wastewater facilities may do so as long as the appeal, if granted,

- Is not detrimental to the public welfare,
- Does not involve special conditions or circumstances that affect the water or wastewater facility in question,
- Is supported by an engineering study performed by a Professional Engineer,
- Is not based on financial interests only.

The final decision of the appeal shall be provided by the Director of Engineering.

1.4 Definitions and Reference Standards

American National Standards Institute (ANSI) Standards – The latest edition of applicable standards as approved and published by the American National Standards Institute, Inc.

American Society of Mechanical Engineers (ASME) Standards – The latest edition of applicable standards as approved and published by the American Society of Mechanical Engineers.

American Society for Testing and Materials (ASTM) Standards – The latest edition of applicable standards as approved and published by the American Society for Testing and Materials.

Apartment – A dwelling unit in an apartment building.

Apartment Building – A building or any portion thereof, which contains three or more dwelling units, located in the same building lot. An apartment building is a multi-family dwelling.

Average Daily Flow – The arithmetic average of all daily flow determinations taken within a period of 24 consecutive hours.

American Water Works Association (AWWA) Standards – The latest edition of applicable standards as approved and published by the American Water Works Association.

Barriers – Railroads, arterial and collector roadways, divided thoroughfares, highways, buildings, man-made or natural obstacles, etc. which restrict Fire Department operations.

CFS – Cubic feet per second.

Carrier Pipe – A pipe used to carry water or wastewater, as opposed to an exterior protective casing pipe.

Casing Pipe/Casing - Encasement pipe, usually steel, that is most commonly used in underground construction to protect utility lines of various types from getting damaged.

Collector – A pipe that is generally between 8 inches and less than 15 inches that collects sewage from neighborhoods and groups of businesses and delivers sewage to a single, larger interceptor pipe.

Connection – The point at which a residential unit or non-residential establishment is provided service by the City water or wastewater system.

Contamination – The presence of any foreign substance (organic, inorganic, radiological, or biological) in water which tends to degrade its quality so as to constitute a health hazard or impair the usefulness of the water.

Director of Engineering – This term shall mean the Director of Engineering or his/her designated representative.

Disinfectant – Any oxidant, including but not limited to chlorine, chlorine dioxide, chloramines, and ozone that may be added to the water in any part of the treatment or distribution process that is intended to kill or inactivate pathogenic microorganisms.

Disinfection – A process which inactivates pathogenic organism in the water by chemical oxidants or equivalent agents.

Distribution System – A system of pipes that conveys potable water from a water treatment plant to consumers. The term includes pump stations, ground and elevated storage tanks, potable water mains, potable water service lines, and all associated valves, fittings, and meters, but excludes potable water customer service lines.

Dimension Ratio (DR) [Pressure Flow] – The outside pipe diameter divided by the pipe wall minimum thickness. The DR provides a method of specifying product dimensions to maintain mechanical properties regardless of size. For a given dimension ratio the pipe stiffness remains constant for all pipe sizes.

Duplex – Two single family dwelling units per lot.

Dwelling – A building or portion thereof designed and used exclusively for residential occupancy, including one- and two-family dwellings but not including hotels, motels, or lodging houses.

Dwelling Unit – A single unit providing complete independent living facilities for one of more persons including permanent provisions for living, sleeping, eating, cooking, and sanitation.

Encasement Pipe – A smooth protective steel pipe which encases a carrier pipe for various types of crossings including roadways, creeks, and railroads.

Engineer of Record – professional engineer, licensed in the State of Texas responsible for the sealing of construction plans, studies, calculations, and/or any other engineering documents.

Firm pumping capacity – The pumping capacity of the station handling the expected peak flow or the maximum hourly demand with the largest pump out of service.

Flushing Duration – The minimum amount of time required to provide a complete change over of water volume within the dead end section of pipeline.

gpad – Gallons per acre per day.

gpd – Gallons per day.

gpcd – Gallons per capita per day.

gpm – Gallons per minute.

Inflow and Infiltration (I&I) - Inflow and infiltration are terms used to describe the ways that stormwater and groundwater enter into dedicated wastewater systems.

Interceptor – A pipe that gathers wastewater flow from several smaller collector pipes.

International Fire Code (IFC) – The latest edition adopted by the City Council of the City of McKinney Texas for the purpose of prescribing regulations governing conditions hazardous to life and property.

Intruder-Resistant Fence – A fence at least 6 feet high, constructed of wood, concrete, masonry, or metal with 3 strands of barbed wire extending outward from the top of the fence at a 45° angle with the smooth side of the fence on the outside wall. In lieu of barbed wire, the fence must be at least 8 feet high. These fences must be in good working order and close enough to the ground to prevent intruder passage beneath the fence.

MGD – Million gallons per day.

Maximum Daily Demand – The total amount of water used during the day of heaviest consumption in any given year and the minimum rate, which the high service pumps must be capable of pumping. Water must be supplied to the pumps at this rate.

Maximum Hourly Demand [Peak Flow] – The rate at which water is drawn from the entire system during the hour of maximum consumption on the day of maximum demand. This rate is generally of a short duration and is most economically provided for by the use of elevated storage in addition to water supplied to the system by pumps. The distribution system, including storage and pumping capacity, must be able to satisfy this demand.

Mils – A unit of length equal to one thousandth of an inch.

Minimum Hourly Demand – This is the rate at which water is drawn from the distribution system during the hour of minimum demand on the day of maximum demand. This demand rate is used in the water distribution analysis to determine the adequacies of the system to replenish elevated storage.

Multi-family – Three or more dwelling units per lot.

National Fire Protection Association (NFPA) Standards – The latest edition of applicable standards as approved and published by the National Fire Protection Association.

North Central Texas Council of Governments (NCTCOG) Public Works Construction Standards – The latest edition of applicable standards as approved and published by the North Central Texas Council of Governments.

North Texas Municipal Water District (NTMWD) – The agency that provides for the potable water needs and wastewater treatment services for the City of McKinney.

Peaking Factor – The maximum flow to average flow ratio used in wastewater flow calculations.

Peak Flow – The highest 2-hour wet weather wastewater flow expected under any operational condition.

psi – Pounds per square inch.

Professional Engineer – An engineer who maintains a current license through the Texas Board of Professional Engineers in accordance with its requirements for professional practice.

Single family dwelling [attached] – A dwelling unit that is joined to another dwelling at one or more sides by a party wall or abutting separate wall, which is designed for occupancy by one family and is located on a separately platted lot, delineated by front, side and rear lot lines and is served by separate utility connections and meters as a single family dwelling (e.g. town homes, condos, etc.).

Single family dwelling [detached] – A dwelling unit designed and constructed for occupancy by not more than one family, located on a lot or separate building tract and having no physical connection to a building located on any other lot or tract, and occupied by only one family.

Standard Dimension Ratio (SDR) [Gravity Flow] – The pipe diameter divided by the pipe wall thickness and provides a method of specifying product dimensions to maintain mechanical properties regardless of size. For a given dimension ratio the pipe stiffness remains constant for all pipe sizes.

TCP – Traffic control plan.

Texas Commission on Environmental Quality (TCEQ) – The environmental agency for the state of Texas which strives to protect our state's human and natural resources consistent with sustainable economic development. Their goal is “clean air, clean water, and the safe management of waste”.

Texas Department of Licensing and Regulation (TDLR) – The state's umbrella occupational regulatory agency which is responsible for the regulation of multiple occupations and industries.

Texas Department of Transportation (TxDOT) – The state’s transportation department that is responsible for planning, designing, building, operating and maintaining the state's transportation system.

Texas Manual on Uniform Traffic Control Devices (TMUTCD) – The state’s manual of standards for a uniform system of traffic control devices for use on streets, roads, and highways within the state.

Water Age – Water age or residence time is the amount of time water spends in the distribution system between the treatment plant and the consumer and is a function of flow rate, distance from the treatment plant, storage, system demand and distribution system network, and other factors.

SECTION 2 GENERAL WATER AND WASTEWATER GUIDELINES

2.1 Compliance with Master Plans

All construction plans, whether they are for a private development or a project of the Capital Improvement Program, submitted to the Director of Engineering for review shall comply with the current Water Master Plan and the current Wastewater Master Plan.

2.2 Construction Standards and Specifications

All work and materials shall be in accordance with the latest editions of the City of McKinney Construction Standards and Specifications and the North Central Texas Council of Governments (NCTCOG) Public Works Construction Standards. Should a conflict be found between the two publications, the City of McKinney Construction Standards and Specifications shall take precedence.

In the event that an item is not covered by the City of McKinney Construction Standards and Specifications, the NCTCOG Public Works Construction Standards shall apply. Notification in writing by the contractor shall be made to the engineer of record, City inspector and the Director of Engineering of the issue. The Director of Engineering shall make the final decision regarding all construction materials, methods, and procedures specified in construction plans. Reference to all documents contained in the project specifications shall refer to the latest edition of each document or the version adopted by the City Council.

2.3 Plan Submittal and Review Process

It is the responsibility of the engineer of record to ensure that all construction plans are in conformance with the latest version of the City of McKinney - Engineering Department – Civil Engineering Plan Submittal Process document.

The engineer of record shall provide either a design study or letter report which provides the water and wastewater demands required for the proposed development.

Unless requested otherwise by the Director of Engineering, the engineer of record shall analyze all existing water and wastewater facilities adjacent to proposed development in order to demonstrate that capacity exists for the proposed development. The analysis, or design study, must also demonstrate that the development will not adversely affect current services.

As part of the Director of Engineering's review process, the City's modeling consultant may review the proposed development for impacts to existing and master planned water and wastewater system, as well as any improvements needed due to the development. The City's consultant will provide the results of the modeling efforts within a brief letter report. The scope and fee for the modeling efforts will be reviewed by the developer and the Director of Engineering for approval. The expense of the modeling efforts and letter report will be reimbursed to the City by the developer.

Plan submittals will be evaluated upon receipt by the Director of Engineering and will be placed on a review priority list after all the required information has been submitted.

2.4 Plan Requirements

It is the responsibility of the engineer of record to ensure that all plans submitted for review adhere to the following guidelines:

Plans shall be clear, legible, and neatly drawn on bordered 22-inch x 34-inch or 24-inch x 36-inch sheets. Each sheet shall clearly display the seal of the Professional Engineer under whose direction the plans were prepared. All engineering documents shall clearly indicate the professional engineering firm name and registration number.

Record Drawings shall include a note/callout for the type of pipe material constructed. These notes/callouts shall be shown on each plan and profile sheet that contains the water and wastewater lines and as directed by the Director of Engineering.

2.4.1 Water and Wastewater Design Criteria

It is the responsibility of the engineer of record to ensure that all construction plans are in conformance with the latest version of the following:

- City of McKinney General Notes
- North Central Texas Council of Governments - Public Works Construction Standard Specifications and Standard Drawings (NCTCOG Specs)
- International Fire Code
- City of McKinney Code of Ordinances
- Rules and Regulations established by the Texas Commission on Environmental Quality (TCEQ)
- Chapter 290 - Public Drinking Water SUBCHAPTER D: RULES AND REGULATIONS FOR PUBLIC WATER SYSTEMS §§290.38 - 290.47
- Chapter 217 - Design Criteria for Domestic Wastewater Systems SUBCHAPTER C: CONVENTIONAL COLLECTION SYSTEMS §§217.51 - 217.70
- American Water Works Association Standards (AWWA)

Line sizes shall comply with the current Water Distribution System Master Plan and the current Wastewater Master Plan.

Water and wastewater lines shall be sized and extended through the limits of a development to provide a connection for ultimate development of adjacent properties.

The acquisition of field data, including wastewater flow monitoring and water system pressure data, shall be at the expense of the developer.

2.4.2 Plan Sheet

The plan view or plan sheet shall include the following:

- In general, plan view sheets should be drawn so that the north arrow points up, left, or right, but not down. Plans shall show a sufficient amount of the surrounding area (i.e. streets, lots, property lines) so that existing water and/or wastewater facilities are shown clearly and so that proper consideration may be given to both existing and future connections to other facilities.
- Drawn to a scale and clearly marked on sheet including a graphical bar scale. The use of non-standard scales will not be permitted. Provide index sheet(s) on plans requiring the use of more than 4 sheets for plan and profile drawings. Table 2-1

provides the acceptable scales for the plan sheets unless otherwise authorized by the Director of Engineering.

TABLE 2-1 – SCALE OF PLANS

1 inch = 20 feet	1 inch = 50 feet
1 inch = 30 feet	1 inch = 60 feet
1 inch = 40 feet	1 inch = 100 feet

- All existing and proposed public and private utilities, fire hydrants, air release valves, blow-off assemblies, and necessary appurtenances shall be shown in plan view.
- All lines shall be numbered, lettered, or otherwise designated to correspond with profile sheets.
- All lines shall show diameter and type of material. Wastewater lines shall show flow direction.
- Stationing shall be shown to the nearest hundredth of a foot and each new line shall begin at full stations (i.e. 0+00, 1+00, etc). Wastewater line stationing shall begin at the downstream end of lines and increase in the upstream direction.
- Stationing shall be provided for all junctions, horizontal points of curvature (PC), horizontal points of tangency (PT), bends, angle points, wyes, cleanouts, manholes, and the centerlines of all streets, alleys, and railroads.
- Curve data including delta, radius, tangent length, curve length, chord length and chord bearing shall be provided for all curved pipe alignments.
- City survey control points and benchmarks shall be used and clearly shown with descriptive locations and elevations. Elevations must be from mean sea level datum.

2.4.3 Profile Sheet

The profile view or profile sheet shall include the following:

- Profile drawings shall be provided for all water lines with a diameter equal to or greater than 12 inches. Profile drawings may also be required for smaller water lines as determined by the Director of Engineering.
- Profile drawings shall be provided for all main line wastewater lines. Profile drawings may also be required for smaller water lines as determined by the Director of Engineering.
- All lines shall be numbered, lettered, or otherwise designated to correspond with plan sheets.
- All lines shall show diameter and type of material and show the flow direction and % slope for wastewater lines.
- Stationing shall be shown to the nearest hundredth of a foot and each new line shall begin at full stations (i.e. 0+00, 1+00, etc.). Wastewater line stationing shall begin at

the downstream end of lines and increase in the upstream direction. Proposed invert/flow line elevations shall be shown at even intervals (i.e. 1+00, 2+00, etc.) and at all match lines.

- Stationing, invert/flow line elevations, and ground elevations shall be provided for all junctions (show all lines in and out), bends, grade breaks, wyes, cleanouts, manholes (label all lines in and out), and ends of lines. Other points may be requested by the Director of Engineering.
- All manholes, cleanouts, valves, and other appurtenances shall be shown.
- Pipe slopes shall be shown to the nearest hundredth of a percent. The type of embedment or encasement and the total linear footage of each line shall be shown.
- Descriptive callouts shall be shown where water and wastewater lines cross. For each utility crossing, it is the responsibility of the engineer of record to specify an appropriate method of protection that meets the requirements of TCEQ.
- Where necessary, existing and proposed parallel storm sewer lines shall be shown in order to verify that all wastewater lateral connections can be made.
- All utility crossings, including storm sewer, gas mains, franchise utilities, etc., shall also be shown and labeled in profile.

2.5 Separation of Water Lines from Wastewater Lines

All water lines and wastewater lines shall be separated per TCEQ Rules and Regulations. Refer to the following:

- Chapter 290 - Public Drinking Water SUBCHAPTER D: RULES AND REGULATIONS FOR PUBLIC WATER SYSTEMS §§290.38 - 290.47
- Chapter 217 - Design Criteria for Domestic Wastewater Systems SUBCHAPTER C: CONVENTIONAL COLLECTION SYSTEMS §§217.51 - 217.70

2.6 State Highway Alignment Criteria

Prior to the design of facilities within TxDOT right-of-way, the engineer of record shall contact the appropriate regulatory agency to determine any special design, construction requirements and/or permitting requirements and shall copy the Director of Engineering on all correspondence with each regulatory agency.

Water and wastewater lines within or crossing a TxDOT right-of-way shall meet the requirements of the TxDOT Collin County Area Office and the TxDOT Utility Manual. Utility permits for lines within or crossing TxDOT rights-of-way shall be processed through the Director of Engineering.

No new wastewater lines will be allowed in the TxDOT right-of-way except for perpendicular crossings.

2.7 Tunneling, Jacking, and Boring

All water and wastewater mains to be installed under existing roadways shall be installed by a method other than open cut, unless otherwise approved by the Director of Engineering. Steel casing shall be a minimum of ½ inch thick and the inside diameter shall be appropriately sized for construction and maintenance of the carrier pipe. The design of the steel casing thickness

shall be verified by the engineer of record. Raci patented casing spacers, or approved equal, shall be used. No bends and/or curves are permitted with casing pipes. Casings shall be required when crossing under existing and proposed arterials, highways, and railroads. Casings may also be required where deemed necessary by the Director of Engineering.

The construction bore and receiving pit shall be located at a minimum distance of 4 feet behind the back of curb. The engineer of record shall provide a distance greater than 4 feet where there is no curb or barrier protection at the edge of pavement. Additional bore setback distances or shoring shall be required to maintain roadway integrity and the safety of construction personnel. When bore and receiving pits are located on private property, permanent water and wastewater easements for the pits will be required for the installation and future maintenance of the line.

- The engineer of record shall design the pipe casing for the following loading conditions and/or applicable combinations thereof:
- Cooper's E-80 Railway loading or AASHTO HS20 loading, as applicable.
- Earth loading with the height of fill above the casing as shown on the plans as existing or finish grade whichever is greater.
- All other applicable loading conditions, including loads applied during transportation and handling.

Engineer of records shall consider the location, size, and depth of bore and receiving pits relative to existing utilities when establishing the beginning and ending stations.

Manufacturers: Paint Manufacturers for pipe casing shall be 46-465 H.B. Tnemecol - Tnemec Inc. or approved equal.

2.8 Crossings

2.8.1 Culvert Crossings

A steel encasement pipe shall be used to encase the carrier pipe with a minimum vertical clearance of 2 feet from the bottom of the culvert. The encasement pipe shall be extended a minimum of 10 feet from the outside edge of a box culvert or the outside diameter edge of the storm sewer for future maintenance of the carrier pipe.

2.8.2 Railroad Crossings

Prior to the design of any railroad crossing, the engineer of record shall contact the railroad and the appropriate regulatory agency to determine if there are any special design and/or construction requirements and shall copy the Director of Engineering on all correspondence with each regulatory agency.

2.9 Easements

All proposed water or wastewater facilities that are outside of public rights-of-way or existing easements, shall be provided with permanent water or wastewater easement. Water and wastewater easements that are parallel to and adjacent to public rights-of-way require approval from the Director of Engineering. The following are guidelines for the easements:

Water and wastewater easements shall have a minimum width of 15 feet additional easement width shall be provided based on depth and diameter of utilities.

Single water or wastewater lines shall be located in the center of the easements. For two or more parallel water and wastewater lines in an easement, maintain the centerline of the utility a minimum of 7.5 feet from the edge of the easement.

The minimum easement width for water and wastewater lines deeper than 10 feet, shall be equal to 1.5 times the depth of the line rounded up to the nearest 5 foot Consider, for example, a wastewater line 12 feet deep. The wastewater easement would be 1.5 x 12 feet = 18 feet, rounded up to the nearest 5 foot = 20 feet. Larger easement widths may be required by the Director of Engineering.

In residential developments, water and wastewater lines shall not cross residential lots unless specifically approved by the Director of Engineering. Water and wastewater easements shall be located completely on one side of a fence or property line.

Fire hydrants located outside of public rights-of-way or adjacent to water line easements shall be in a 15 feet x 15 feet water easement.

Two inch and smaller water meters serving multi-family residential and non-residential developments shall be in a minimum 5 feet x 5 feet water easement. Three inch and larger meters shall be in a minimum 15 feet x 20 feet water easement and shall not be within the public right-of-way.

Temporary construction easements shall be provided to allow for construction operations for the installation.

Non-residential 3 inch and larger water meters shall be located in a water easement and clear of high traffic areas. Water meter vaults shall be sized according to the size of the water meter. Minimum water meter vault sizes and easement sizes are as follows:

- 3 inch meter - 6 feet x 8 feet (15 feet x 20 feet water easement)
- 4 inch meter - 6 feet x 8 feet (15 feet x 20 feet water easement)
- 6 inch meter - 8 feet x 10 feet (20 feet x 20 feet water easement)
- 8 inch meter - 8 feet x 12 feet (20 feet x 20 feet water easement)

Permanent water or wastewater easements are required when boring and receiving pits are located on private property. The boring and receiving pit areas are necessary for future maintenance of the line.

Access easements shall be provided to all water and wastewater easements located on private property.

SECTION 3 WATER SYSTEM DESIGN CRITERIA

3.1 Water Demand

Residential development submittals shall include the total number of units and the total acres of the proposed development. Non-residential development submittals shall include estimated water use records showing the minimum hourly demand, maximum hourly demand, maximum daily demand, total building square footage, and the total acres for the proposed development. The projected maximum daily demand and maximum hourly demand shall be calculated and shown in MGD in accordance with the current Water Master Plan.

3.2 Water Supply

The North Texas Municipal Water District (NTMWD) supplies treated water at the McKinney Ranch Parkway Pump Station, University Pump Station, and the Gerrish Street Pump Station as shown in the Water Master Plan.

3.3 Pressure Planes

The City currently operates three pressure planes, the 794 Service Area, the 850 Service Area and the 920 Service Area. A proposed fourth pressure plane, the 840 Service Area, was established to provide pressure between 40 and 95 psi. It is envisioned that the proposed 840 Service Area will be supplied by the 794 Service Area and pressurized with a booster pump station and pneumatic tank. The locations of the existing and proposed pressure planes are shown on the Water Master Plan Map.

The service area elevation designation is related to the high water level (HWL) of elevated storage tanks.

Prior to the design of a water system, the engineer of record shall investigate and determine if the proposed water main crosses the boundary between any of the pressure planes. For those pressure planes separated by a street, a main shall be provided for each pressure plane on their respective side of the street. Proposed mains that approach pressure zone boundaries shall be designed to loop within their designated pressure planes as shown in the Water Master Plan.

3.4 Sizing Water Distribution Mains

The design of the water distribution system involves various rates of water use, which are generally referred to as water demand. Water demand rates are generally expressed in MGD. The three most significant water demand rates are Maximum Daily Demand, Maximum Hourly Demand and Minimum Hourly Demand.

For any residential development where the lot layout has not been finalized, the following Table 3-1 shall apply:

Table 3-2 provides the water demand for non-residential land uses.

TABLE 3-1 – RESIDENTIAL WATER DEMAND BY LAND USE

District	Land Use	Estimated Units Per Acre	Population Per Unit	Maximum Daily Demand (gpad)	Maximum Hourly Demand (gpad)
RED-1	Estate	1.0	3.2	1,600	3,520
RED-2	Estate	0.5	3.2	800	1,760
RS-120	Single Family	2.7	3.2	4,356	9,583
RS-84	Single Family	3.9	3.2	6,223	13,690
RS-72	Single Family	4.5	3.2	7,260	15,972
RS-60	Single Family	5.4	3.2	8,712	19,166
RS-45	Single Family	7.2	3.2	11,616	25,555
RS-30	Duplex	5.4	2.5	6,806	14,974
RG-27	General - Townhome	12.1	2.0	12,100	26,620
RG-25	General	13.1	2.0	13,068	28,750
RG-18	General	24.0	2.0	24,000	52,800
MF-1	Multi-Family Low Density	12.0	2.5	15,000	33,000
MF-2	Multi-Family Medium Density	16.0	2.5	20,000	44,000
MF-3	Multi-Family High Density	20.0	2.0	20,000	44,000
MP	Mobile Home Park	8.0	2.0	8,000	17,600

TABLE 3-2 – NON-RESIDENTIAL WATER DEMANDS BY LAND USE

Land Use	Max. Daily Demand (gpad)	Max. Hourly Demand (gpad)
Neighborhood Commercial / Office	1,500	2,700
Schools	39 gpcd	52 gpcd
Light Manufacturing*	2,000	3,000
Heavy Manufacturing*	2,500	3,000
Regional Commercial	3,000	3,900
Regional Employment Center*	3,000	4,500
Office Park	6,000	6,000
Parks and Open Space	1,500	1,500
Golf Course**	1,000	1,000
Hospital	720 gpd per bed	864 gpd per bed
Nursing Home	240 gpd per bed	288 gpd per bed
Restaurant	22 gpcd	26 gpcd

* Developer/engineer of record shall provide the maximum daily demand and maximum hourly demand flows and/or the number and size of water meters proposed for the particular land use for review by the City.

** Developer/engineer of record shall provide the number and size of water and irrigation meters proposed for the golf course for review by the City.

Land uses not listed shall be classified by the land use they most nearly resemble in Table 3-2 or calculated by the engineer of record in accordance with the anticipated use. The engineer of record shall submit the Maximum Daily Demand and the Maximum Hourly Demand to the Director of Engineering for review and approval.

The engineer of record shall contact the Director of Engineering to obtain the map of existing pressure ranges for the project area during maximum daily demands and/or determine the size of water main required from the Water Master Plan. For all developments, re-developments, and any type of facility tying into the City's water distribution system, the following guidelines shall be used:

- The engineer of record shall obtain the available record drawings from the City GIS Department. When record drawings are not available, field investigations and verifications shall be required prior to construction.

- The standard water line sizes that shall be used are noted in the Table 3-3.

TABLE 3-3 – STANDARD WATER LINE SIZES

8 inch	12 inch	16 inch
20 inch	24 inch	30 inch
36 inch	42 inch	54 inch
60 inch	66 inch	72 inch

- Fire flows for all districts shall be calculated with a minimum residual pressure of 20 psi under combined fire and domestic (Maximum Daily Demand) water flow conditions and/or the latest requirement by the TCEQ.
- Mains are to be sized to ensure less than 1 foot of head loss per 1000 feet of water main using a Hazen Williams coefficient of C = 100 for the Maximum Hourly Demand flow rates within the subdivision internal distribution system.
- Mains shall be sized to provide service to adjacent properties.

3.4.1 Single Family Residential

Twelve inch mains shall be required along all collector streets and other areas as determined by the Director of Engineering. Eight inch mains are required along smaller residential streets.

3.4.2 Multi Family Residential

Minimum size main in any multi-family project shall be 8 inches

Mains over 600 feet in length between intersecting mains or mains supplying more than one fire hydrant/fire service line shall be 12 inch diameter, otherwise the main may be 8 inches.

3.4.3 Non-Residential

Mains over 1,000 feet in length between intersecting mains or mains supplying more than two fire hydrants/fire service lines shall be 12 inch diameter, otherwise the main shall be 8 inches

Eight inch mains may be used for fire hydrants located in parking lots not adjacent to buildings, and shall be looped.

3.5 Horizontal Alignment and Vertical Alignment

The following guidelines shall be used for the placement of water lines:

- Water lines shall be placed on the north and east side of the roadway right-of-way whenever possible. Where it is not possible to install the main inside of the right-of-way, an easement shall be required. Water mains in right-of-way are to be placed at a distance of 5 feet from the back of the curb, for 6 inch, 8 inch and 12 inch lines. Water mains larger than 12 inches in right-of-way shall be installed at least 5 feet from the back of curb to outside of the pipe, or otherwise directed by the Director of Engineering.

- Water mains shall be extended through the limits of a development to serve adjacent properties. In phased construction of roadways, the water main shall be extended the entire length of the roadway being constructed.
- Sixteen inch and larger water lines shall be designed in straight alignments if possible. Avoid excessive number of high points and low points between cross street connections.
- Minimum radius of curve and maximum deflection angle of pipe joints will be restricted to 75% of manufacturer's recommendation, after which the use of horizontal or vertical bends will be required.
- All vertical and horizontal bends, plugs, reducers and tees shall be restrained joints. When multiple vertical bends are required for utility clearances, all fittings are to be designed with restrained joints in addition to concrete thrust blocking.

3.6 Depth of Cover

The minimum depths of cover for water lines are indicated in Table 3-4.

TABLE 3-4 – DEPTH OF COVER TO TOP OF PIPE

Pipe Size	Minimum Depth of Cover
6 inch through 8 inch	4 feet
12 inch through 16 inch	5 feet
20 inch and larger	6 feet

The engineer of record shall consider the ultimate roadway elevations in determining the depth of cover. Additional depth of cover shall be required for future development and as directed by the Director of Engineering. Depths of cover greater than 8 feet shall be approved by the Director of Engineering.

3.7 Pipe Material

The specification of pipe material is the responsibility of the engineer of record based on the analysis of specific site, soil conditions, loading conditions, and pressure requirements. The following guidelines, in Table 3-5, are based on pipe size only and in no way relieve the engineer of record of the responsibility of pipe material specifications applicable to the particular job and restrictions due to special construction methods.

TABLE 3-5 – PIPE MATERIALS

Internal Diameter Pipe Size	Pipe Material
4 inch through 12 inch	• **PVC,** AWWA C900, minimum DR 18 • **Ductile Iron,** AWWA C151 Pressure Class 350 (cement mortar lined polyethylene encased) • **HDPE,** AWWA C901/C906, minimum DR 9 ASTM F714**,**
16 inch through 20 inch	• **Ductile Iron,** AWWA C151, (cement mortar lined, polyethylene encased) working pressure of 150 psi with 100 psi surge pressure • **Bar Wrapped Concrete Steel Cylinder**, AWWA C303, working pressure of 150 psi with 100 psi surge pressure • **HDPE,** AWWA C901/C906, minimum DR 9, ASTM F714 working pressure of 150 psi with 100 psi surge pressure
24 inch and larger	• **Ductile Iron,** AWWA C151, working pressure of 150 psi with 100 psi surge pressure (cement mortar lined, polyethylene encased) • **Bar Wrapped Concrete Steel Cylinder**, AWWA C303, working pressure of 150 psi with 100 psi surge pressure; Steel Pipe, AWWA C200 working pressure of 150 psi with 100 psi surge pressure (cement mortar lined and encased). • **Steel,** AWWA C200 and C205, working pressure of 150 psi with 100 psi surge pressure (cement mortar lined and polyurethane coating applied to the exterior) polyurethane coating shall utilize plural component polyurethane products, Corropipe II Omni manufactured by Madison Chemicals or approved equal.

Additional specifications for the above referenced pipes are as follows:

Bar Wrapped Concrete Steel Cylinder Pipe, AWWA C303, (Reinforced Concrete Cylinder Pipe (RCCP)).

- Flexible joint couplings shall be equal to Smith-Blair Style 441, or approved equal.
- Cathodic test stations spaced at 600 foot intervals shall be required on 24 inch and larger diameter pipes.

Steel Pipe

- Design fittings, special, associated joints and all field and shop welds with load capacities equal to or greater than those of connecting pipe segments.

- Design bulkhead, closure, or test plug, as needed for closure of sections and for field hydrostatic testing.
- Design and locate weld lead outlets as needed.
- Design and locate flush and sampling ports, as needed, for hydrostatic testing and disinfection.
- Cathodic test stations spaced at 600 foot intervals shall be required on 24 inch and larger diameter pipes.

HDPE Pipe

- Formulated with carbon black and/or ultraviolet stabilizer.

Manufacturers

Joint Wrappers

- Mar-Mac Manufacturing Company or approved equal

Flexible Joint Couplings

- Smith-Blair, Inc. or approved equal

3.8 Fittings

All valves and fittings shall be restrained with Mega-lug or approved equal.

Fittings shall be ductile iron in accordance with AWWA C110 or AWWA C153. All buried metal shall be wrapped in polyethylene tube wrap.

Gaskets ANSI/AWWA C111/A21.11 shall be neoprene or other synthetic rubber. Natural rubber will not be accepted.

All bolts and nuts shall be ASTM A325 Type III Enhanced Corrosion Resistant steel, or stainless steel Grade 304 or 316.

Manufacturers

Mechanical Restraints

- EBAA Iron, Inc. - Mega-lug or approved equal
- BullDog™ Integral Joint Restraint System for C900 pipe or equal

3.9 Pipe Embedment

The type of embedment for water mains less than 16 inch diameter shall be NCTCOG Class “H” embedment extended to 12 inches minimum over the top of pipe.

For pipe sizes 16 inches and greater, the embedment class shall be a function of the pipe material selected including dead and live load considerations provided by the engineer of record. The engineer of record shall submit calculations on the embedment selected for the particular pipe type.

Trench dams may be required by the Director of Engineering depending on the ground water potential, pipe slope and length of sloped line segments.

3.10 Dead-End Mains

Dead-end mains shall be avoided and may only be considered when a looped or interconnected water main system is not available. The design of all water distribution systems should include the opportunity for future looping or interconnect of any approved or proposed dead-end line.

All dead-end lines shall only be installed when approval is obtained from the Director of Engineering and their maximum length shall be 150 feet.

Residential cul-de-sac dead end lines shall be reduced down to 4 inch diameter from the beginning of the cul-de-sac bulb to the last household water service connection. The fire hydrant lead shall be installed prior to the reduction of the main line size.

Where dead-end mains are approved, the engineer of record shall provide an automatic flush valve and a 2 inch minimum blow-off valve assembly or a fire hydrant within 5 feet of the end of the dead-end main. The blow-off valve or fire hydrant will be utilized by the Public Works Department to maintain water quality.

Manufacturers

Flush Valve

- Automatic Flush Device – Model No. 9800WC ECLIPSE™ manufactured by Kupferle Foundry Company or approved equal.

3.11 Creek Crossings

Water lines constructed under any flowing stream or semi-permanent body of water, such as a marsh or pond, shall be installed inside a separate watertight encasement pipe. Water lines shall have isolation valves on each side of the crossing.

The engineer of record shall determine the type and limits of any special embedment, and specify the limits for specialized backfills to prevent soil erosion at the areas of trench backfill and as approved by the Director of Engineering.

Bank stabilization shall be provided for existing creek and ditch embankments disturbed by construction operations in accordance with the latest edition of the Streambank Stabilization Manual prepared by Halff Associates, Inc., dated June 1998 and as approved by the Director of Engineering.

3.12 Fire Hydrants

3.12.1 Fire Hydrant Spacing

Fire Hydrants shall be located to provide the Required Fire Flow, in accordance with the provisions of the McKinney Fire Code.

3.12.1.1 Single Family Residential

- Fire hydrants shall be located at all intersecting streets and at intermediate locations between intersections as necessary to provide a maximum spacing of 500 feet between fire hydrants as measured along the route. The route shall be clear of permanent barriers and adjacent private property.

3.12.1.2 Multi-Family Residential

- Multi-Family Residential - Fire hydrants shall be located at all intersecting streets and at intermediate locations between intersections as necessary to provide a maximum spacing of 300 feet as measured along the length of the centerline of the fire lane or roadway. Any structure at grade shall be no further than 500 feet from at least two fire hydrants as measured along the route. The route shall be clear of permanent barriers and adjacent private property.
- At least one fire hydrant shall be within 100 feet of any Fire Department Connection as described in Section 3.13 Fire Department Connections.
- Fire hydrants shall be at least 35 feet from all buildings.

3.12.1.3 Non-Residential

- Non-Residential Property - As the property is developed, fire hydrants shall be located at all intersecting streets and at intermediate locations between intersections as necessary to provide a maximum spacing of 300 feet as measured along the length of the centerline of the fire lane or roadway. The front of any building at grade shall be no further than 300 feet from a minimum of two fire hydrants as measured along the route. The route shall be clear of permanent barriers and adjacent private property.
- Fire Sprinkler System Stubout - The City Fire Marshal shall approve the vault, fittings, valves, double detector check, etc. and will issue a separate permit for fire
- Fire hydrant spacing shall be in accordance with Appendix C of the current International Fire Code as adopted by the City of McKinney.
- At least one fire hydrant shall be within 100 feet of any Fire Department Connection as described in Section 3.13 Fire Department Connections.
- Location of fire hydrants shall be installed outside of the PCs and PTs of curve radii of fire lanes (no fire hydrants shall be located within the radius delta angle between the PC and PT of the curve). Fire hydrants shall be at least 35 feet from all buildings.
- Where access could be blocked due to a barrier between the fire hydrant and the building which it is intended to serve, additional fire hydrants shall be provided to improve the fire protection.

3.12.1.4 Spacing along Arterials

Where new water mains are extended along streets where hydrants are not needed for protection of structures or similar fire problems, fire hydrants shall be provided at spacing not to exceed 1,000 feet to provide for transportation hazards.

3.12.2 Fire Hydrant Installation

Fire hydrants shall be located a minimum of 3 feet and a maximum of 6 feet from the fire lane or roadway as measured from the centerline of the fire hydrant to back of curb, edge of pavement or fire lane.

A 3 feet clear radius shall be maintained for access and operation of the fire hydrant.

Fire hydrants placed on private property shall be located in water easements and adequately protected behind a curb or curb stop, pipe bollards, or other methods as approved by the Director of Engineering and the Fire Department. Curb or curb stop, pipe bollards, or other methods shall be the responsibility of the landowner.

Fire hydrants located on public or private property shall be accessible to the Fire Department at all times.

Fire Hydrants are not permitted in the bulb of a cul-de-sac.

3.12.3 Fire Hydrant Leads

Fire hydrant leads shall be a minimum of 6 inches and have a bury depth of 4 feet.

Valves shall be placed on all fire hydrant leads. The connection to the main line shall include a flanged tee connected to a flange by mechanical joint gate valve. The mechanical joint shall be restrained so that the valve is anchored to the main.

Eight inch mains shall be connected so as to serve not more than two fire hydrants located between intersecting mains. Every development shall provide adequate water capacity for fire protection purposes. The procedure for determining fire flow requirements for building or portions of buildings shall be in accordance with the International Fire Code. The minimum required fire flow shall be 1,500 gpm at 20 psi.

Six inch fire hydrant leads shall not exceed 100 feet

Existing 4 inch mains used for hydrant supply shall be replaced and dead-ends eliminated where practical.

Existing 6 inch lines shall be connected so that not more than one fire hydrant shall be between intersecting lines.

For main replacement projects in established neighborhoods, fire hydrants should be designed as close as possible to the old fire hydrant location, provided coverage is adequate. Fire hydrants shall not be installed closer than 9 feet to any wastewater main or any wastewater appurtenance.

3.12.4 Painting and Marking

3M Raised Pavement Marker RPM PSA-295 Blue or approved equal shall be placed at the center of the street or fire lane at each fire hydrant. At intersections, reflectors shall be placed on both roadways.

The fire hydrant shall be painted with two coats of Tnemec Series 530 Omnithane paint or approved equal, and two coats of primer. Bonnet to flange and nozzle caps of Fire Hydrant to be painted with two coats of Tnemec Safety Paint Series 2H “Hi-Build” according to the following Table 3-6:

TABLE 3-6 – FIRE HYDRANT COLOR (BASED ON RATED CAPACITY)

Rated Capacity @ 20 psi	Color
1,500 gpm or greater	Light Blue
1,000 – 1,499 gpm	Green

500 – 999 gpm	Orange
Less than 500 gpm	Red

Note: Fire Prevention Inspectors perform water flow tests on selected hydrants when specifically requested from a consultant or developer who needs the information to perform the hydraulic calculations related to their design.

3.12.5 Specifications

Fire hydrants shall be three-way breakaway type no less than 5-1/4 inch size and must conform to AWWA specifications C502 with bronze to bronze moving parts. Two 2-1/2 inch NST hose connections are required. The required 4 inch diameter steamer connection shall be 4.800 pitch with four threads per inch. The operating nut shall be 1-1/2 inch P to F pentagon nut, open left. Mechanical joint connection is required.

3.12.6 Public and Private Fire Mains

Fire flow requirements for buildings shall be in accordance with Appendix C of the current City adopted International Fire Code. Public and private fire protection water mains shall be installed according to the NCTCOG, N.F.P.A. 24 and the current City adopted International Fire Code.

Manufacturers

Paint

- Tnemec Series 530 Omnithane Paint and Tnemec Safety Paint Series 2H “Hi-Build” - Tnemec Inc. or approved equal

Raised Pavement Markers

- 3M
- Roadrunner Traffic Supply, Inc.
- Centerline Supply

Fire Hydrants

- Mueller Water Products, Inc. – “Super Centurion”
- Clow Valve Company – “Medallion”
- American Flow Control – American Cast Iron Pipe Company - “Waterous Pacer”
- M&H Valve Company - “Reliant 129”

3.13 Fire Department Connections

At least one fire hydrant shall be within 100 feet of any Fire Department Connection (FDC).

Fire lines exceeding 100 feet shall be required to install a backflow preventer in a concrete vault near the fire service line connection to the City’s recirculating water line.

The City Fire Marshal shall approve the construction plans for the vault, fittings, valves, double detector check, etc. and will issue a separate permit for fire sprinkler systems.

3.14 Valves

The following guidelines should aid the engineer of record in placement of valves on proposed water mains:

- Valves are to be located at street intersections at or near side property lines, unless a specific construction issue requires the placement of the valve at a nonstandard point of connection.
- Valves 12 inches and under shall be Resilient Wedge Gate Valves (RWGV). Valves shall be spaced 600 feet or less in a single family residential district and 500 feet or less in all other districts. Valves shall be placed in such a manner as to require two, but not more than three valves to shut down each main segment without shutting off more than one fire hydrant.
- Sixteen inch and larger valves may be butterfly type and shall be spaced at a maximum of 1,000 foot intervals. All valves shall have horizontal mounted actuators with a manhole for access to the actuators.
- Valves shall be placed at or near the ends of mains in such a manner that a shut down can be made for a future main extension without causing loss of service on the existing main. A minimum of 20 feet of main shall be installed past the valve and mechanical pipe thrust restraints shall be used to anchor it.
- Where fire lines are connected to the water main, valves shall be installed on both sides of the connection to provide the ability to isolate the main line and continue to provide water to the fire line. The fire line shall be provided with a valve at the connection with the main line.
- Valve boxes shall be provided for buried valves. They shall be three-piece screw-type cast iron boxes of the extension type. The three pieces shall consist of the top section, bottom section and cover.
- Two inch square nuts that would be over 5 feet deep shall have valve stem extensions. In these cases, the 2 inch square valve operating nut shall be no greater than 2 feet from the finish grade. Valve box extensions may be cast iron or PVC.

Manufacturers

Valve Boxes

- East Jordan Iron Works, Inc.
- Tyler Union

Valves

- Mueller Water Products, Inc.
- M&H Valve Company
- American Flow Control – American Cast Iron Pipe Company
- Clow Valve Company

3.15 Air Release, Air/Vacuum and Combination Air Valves

Air release valves, air/vacuum and combination air valves shall be required on 16 inch and larger water lines and as necessary for proper system operation. There are three primary functions of the valves that the engineer of record shall consider as follows:

- to vent large volumes of air during filling of the line,
- to allow air into the pipe during emptying for maintenance and/or repairs,
- to vent small volumes of air that come out of solution during service.

Typically these are installed at high points where the pipeline has a vertical change in gradient. Additional installation locations may be requested by the Director of Engineering.

A fire hydrant shall be required at high points on 12 inch water lines for air relief and flushing maintenance operations. When a fire hydrant cannot be used, an air release valve may be approved by the Director of Engineering.

Manufacturers

Air Release and Vacuum Valves

- VENT-O-MAT Model RBX or approved equal

3.16 Flush Valves

Fire hydrants or corporation stops and automatic flush valves can be used as flush valves.

A corporation stop shall be a 2 inch minimum ball type with compression inlet fitting with tee head shut off and a compression outlet fitting, designed for a minimum working pressure of 300 psi. The 2 inch curb stop shall be ball type with compression inlet fitting Pipe shall be 2 inch diameter, DR-9 (250 psi) HDPE poly pipe with PE4710 as specified in ASTM F714.

Automatic Flush Valves may be required by the Director of Engineering.

Manufacturers

Flush Valve

- Automatic Flush Device – Model No. 9800WC ECLIPSE™ manufactured by Kupferle Foundry Company or approved equal.

3.17 Water Services

All water services and water meters shall be size on size. No reductions in water meter sizing are allowed for single services.

All water services shall be 3/4 inch minimum DR-9 (250 psi) HDPE poly pipe with PE4710 as specified in ASTM F714, 3/4 inch minimum compression fitting angle stop, and meter box, unless otherwise indicated on the plans. Curb stops will be located within the meter box and facing toward the lot. Water services with ¾ inch sizes will be allowed if the lot size is less than 10,890 square feet, the dwelling square footage is less than 2,500 square feet. The water service size for apartment, condominium, or multi-family services will depend on the number of units being served with a minimum of one meter per building.

Corporation and curb angle stops shall be 3/4 inch minimum ball type with compression outlet fitting, designed for a minimum working pressure of 300 psi with a full port design. Curb stop shall be angle set with compression inlet fitting and lock ring.

Detector pads embedded in sand shall be installed above all service connections.

Bullhead water services (dual meter box with single water service line tap) are required in single family residential developments. Bullhead water services shall be 2 inch minimum DR-9 (250 psi) HDPE poly pipe with PE4710 as specified in ASTM F714, 2 inch minimum compression

service pipe inlet and two 1 inch minimum compression service pipe outlets, “U” branch and meter box.

All water services shall be located along the lot lines or adjacent property lines.

All water service lines shall be embedded with 6 inch sand below and around the pipe and 1 foot of sand over the top of the pipe; from the water main to the meter. Water service lines within City roadway right-of-way shall be compacted to a minimum of the 95% Standard Proctor density within +/- 3% optimum moisture content.

Service saddle shall be double bronze flattened straps (no banded straps shall be allowed) with brass body or stainless steel double bolt wide straps with stainless steel body. Minimum size tap shall be 1 inch diameter using a stainless steel single strap with a minimum 2 inch band width. All service saddles shall be brass and shall be Ford, Cambridge, A.Y. McDonald, or Mueller Water Products, Inc.

A domestic service connection shall not be allowed on fire hydrant leads.

All meters will be placed at the property / right-of-way line or within the easement. All meters supplied by the City of McKinney will be at contractor’s expense. Concrete meter vaults are required for meter sizes 3 inches and larger and shall be provided by the contractor.

In single family residential districts, the nearest edge of the water meter box shall be a minimum of 6 inches behind the back of curb, and the water service shall be no more than 12 inches deep, covered with a meter box in place at grade. If no curb is present, the water service shall be located at the property line, no more than 12 inches deep, covered with a meter box in place at grade. Along roadways without a curb, the water service line shall be constructed at a minimum of 18 inches below the ditch flow line.

Water meter boxes shall be provided for each service as per City Specifications.

Each meter box will be located adjacent to the curb and installed after street pavement has been completed and curbs backfilled. Single meter box shall be DFW 37C-SKSBSM for ¾ inch and 1 inch meters and shall be D1730-18-SKSBSM or equal for 1-1/2 inch to 2 inch meters. A 2 inch minimum metal locator plate shall be placed in the recess of the meters.

Commercial water meters will be located in a water easement and clear of high traffic areas. Water meter vaults shall be sized according to the size of the water meter. Minimum water meter vault sizes are as follows:

3 inch meter - 6 feet x 8 feet

4 inch meter - 6 feet x 8 feet

6 inch meter - 8 feet x 10 feet

8 inch meter - 8 feet x 12 feet

Requests for meters larger than those indicated above should be submitted with an installation detail specifying dimensions, materials and location of the water meter vault for review and approval by the Director of Engineering.

Installation of commercial meters will include two mainline valves, one bypass valve with chain and lock, a strainer, and bypass line, all located inside the vault. Clearances between fasteners on valves, strainers and meters to interior surfaces shall provide adequate room for maintenance.

Manufacturers

Service Saddles

- Ford
- Cambridge
- A.Y. McDonald
- Mueller Water Products, Inc.

Domestic Water Meters

- ¾ inch and 1 inch meters - Multi Jet manufactured by Master Meter, Inc. or approved equal.
- 2 inch through 6 inch meters- Dual Body Compound manufactured by Master Meter, Inc. or approved equal.
- 8 inch and 10 inch meters - Dual Body Compound manufactured by Master Meter, Inc. or approved equal.
- 12 inch meters - MMT Turbine meters manufactured by Master Meter, Inc. or approved equal.

Irrigation Water Meters

- ¾ inch and 1 inch meters - Multi Jet manufactured by Master Meter, Inc. or approved equal.
- 2 inch through 12 inch meters - MMT Turbine meters manufactured by Master Meter, Inc. or approved equal.

Meter Boxes

- DFW Plastics, Inc. or approved equal.

Precast Concrete Meter Vaults

- Park Environmental Equipment Company or approved equal.

3.18 Connections to Existing Water Mains

3.18.1 Tapping Sleeves and Valves

Size on size tapping sleeves are not allowed. The largest allowable tapping sleeve shall be the main line size less one standard pipe size (Example: 16 inch x 12 inch, 8 inch x 6 inch, etc.). If a size on size connection is required then a cut-in connection shall be used.

Connections to an existing line shall be made with full body stainless steel tapping sleeve and valve. A resilient wedge gate valve shall be flanged to the tapping sleeve.

3.18.2 Cut-In Connection

When connecting to an existing main, it may be required to provide a cut-in connection with a tee and valve being installed into the existing main in lieu of a tapping sleeve and valve as directed by the Director of Engineering. A test shut down of the existing water main(s) shall be conducted by the City of McKinney Public Works Department, prior to preparation of the

final design plan. The requirement for a test shut-down may be waived with approvals of the Director of Engineering and the Water Superintendent.

3.18.3 Four–Way Connections

When two water mains cross and one of the mains is 16 inches or larger, the connection shall be made by means of a Type "D" connection. The connecting "D" section of water line shall be, at a minimum, equal to the size of the smaller of the two crossing water lines. A valve shall be provided in the "D" section of pipe to isolate the two crossing mains. The installation of a cross fitting shall not be allowed unless approved by the Director of Engineering.

3.18.4 Requirements for Abandoning Water Lines

The engineer of record is to note the limits and appropriate conditions for abandoning existing water lines that are being replaced.

The engineer of record shall make allowances to permit the existing and proposed mains to remain in service simultaneously thereby providing a means for transferring customer's services from the old main to the new main with minimum interruption. If the construction of a proposed main necessitates the abandoning of the existing main prior to the new main's placement into service, then provisions for a temporary water main with services must be addressed with the design.

Existing fire hydrants located on mains being abandoned are to be removed and delivered to the City of McKinney Public Works Department

3.18.5 Replacement Lines

To replace an existing line, the new line should be designed parallel to the line being replaced. The engineer of record shall perform a field investigation to determine pavement condition over the existing main. Based on this field investigation, the engineer of record shall include additional quantities for pavement replacement, if needed. Also, locate the proposed main at least 5 feet away from the existing curb to avoid damaging the curb or undercutting the pavement during installation of the proposed line. On lines being abandoned, the engineer of record should note and locate points of cut and plug at the junction with the line that remains in service.

Manufacturers

Tapping Sleeves

- Mueller Water Products, Inc.
- American Flow Control – American Cast Iron Pipe Company
- Smith-Blair, Inc.

SECTION 4 WASTEWATER DESIGN CRITERIA

4.1 Design Flow

Residential development submittals shall include the total number of units and the total acres for the proposed development. Non-residential development submittals shall include total building square footage, the planned use for the building, and total acres for the proposed development. The projected wastewater flows shall be calculated and shown in MGD in accordance with the City's Wastewater Master Plan and per TCEQ Chapter 217.

All wastewater collection systems must be designed to convey the peak wet weather flow from the entire service area including offsite areas throughout the system. Basin delineation shall be provided using NCTCOG, LIDAR or surveyed contours. Contours shall be provided on 2 foot or less intervals. USGS topo is not permissible.

Flow calculations must include the specifics of the average dry weather flow and the dry weather flow peaking factor.

Flow calculations must denote the flow expected in the facility immediately upon completion of construction and at the end of its 50-year life cycle.

4.2 Sizing Wastewater Collection Mains

To calculate sewer flows, use the following design parameters to calculate the average daily flow. The collection system shall be designed based on the peak flow calculations.

For replacement of existing sewer and construction of parallel sewers for additional capacity, wastewater flow data will be provided by the Director of Engineering from data generated by the Wastewater Master Plan computer model developed by the Director of Engineering. Wastewaters with direct connections to service lines shall be designed to be no more than 70% full and interceptors shall be designed for 100% full.

Proposed parallel wastewater lines adjacent to existing wastewater lines shall be sized to eliminate surcharge in the existing lines.

Table 4-2 summarizes the non-residential land use demand rates.

TABLE 4-1 – RESIDENTIAL WASTEWATER FLOWS BY LAND USE

District	Land Use	Estimated Units Per Acre	Population Per Unit	Average Daily Flow @ 100 gpcd (gpad)
RED-1	Estate	1.0	3.2	320
RED-2	Estate	0.5	3.2	160
RS-120	Single Family	2.7	3.2	871
RS-84	Single Family	3.9	3.2	1,245
RS-72	Single Family	4.5	3.2	1,452
RS-60	Single Family	5.4	3.2	1,742
RS-45	Single Family	7.2	3.2	2,323
RS-30	Duplex	5.4	2.5	1,361
RG-27	General - Townhome	12.1	2.0	2,420
RG-25	General	13.1	2.0	2,614
RG-18	General	24.0	2.0	4,800
MF-1	Multi-Family Low Density	12.0	2.5	3,000
MF-2	Multi-Family Medium Density	16.0	2.5	4,000
MF-3	Multi-Family High Density	20.0	2.0	4,000
MP	Mobile Home Park	8.0	2.0	1,600

TABLE 4-2 – NON-RESIDENTIAL WASTEWATER FLOWS BY LAND USE

Land Use	Average Daily Demand (gpad)
Neighborhood Commercial / Office	1,200
Schools	30 gpcd
Light Manufacturing	1,700
Heavy Manufacturing	2,200
Regional Commercial	2,400
Regional Employment Center	2,400
Office Park	4,500
Parks and Open Space	150
Golf Course	100
Hospital	650 gpd per bed
Nursing Home	220 gpd per bed
Restaurant	18 gpcd

Note: Land uses not listed shall be classified by the land use they most nearly resemble in Table 4-2 or calculated by the engineer of record in accordance with the anticipated use. The engineer of record shall submit the average daily demand and peak flow calculations including off-site flows within the drainage basin to the Director of Engineering for review and approval.

4.2.1 Peak Flow Factor

Peak flow factors are as follows:

- For average daily flow less than 0.35 MGD – Peak Flow Factor = 5.
- For average daily flow between 0.35 MGD and 2.00 MGD - Peak Flow Factor = 4
- For average daily flow greater than 2.00 MGD - Peak Flow Factor = 3.

4.2.2 Inflow and Infiltration

After determining the peak flow amount, the engineer of record shall add an average daily inflow and infiltration rate of 650 gpad.

The engineer of record shall obtain the available record drawings from the City GIS Department. When record drawings are not available, field investigations and verifications shall be required prior to construction.

The engineer of record shall contact the Director of Engineering to obtain contact information for the City consultant maintaining the City's wastewater collection system model and/or determine the size of wastewater main required from the Wastewater Master Plan.

The standard wastewater line sizes that shall be used are noted in the Table 4-3.

TABLE 4-3 – STANDARD WASTEWATER LINE SIZES

6 inch	8 inch	10 inch
12 inch	15 inch	18 inch
21 inch	24 inch	27 inch
30 inch	33 inch	36 inch
39 inch	42 inch	48 inch
54 inch	60 inch	----

4.3 Horizontal Alignment and Vertical Alignment

The following guidelines shall be used for the placement of wastewater lines:

- Horizontal curves will be allowed along centerlines of curved residential streets.
- Vertical curves are not allowed.
- For new construction in open space areas, sewer mains shall be laid straight between manholes.
- When the locations are known, services for future lots shall be installed.
- Alignment should follow the centerline of right-of-way and/or easements, unless approved otherwise by the Director of Engineering.
- For main replacement projects, when flow permits, 8 and 10 inch mains should be replaced in the same alignment.
- Public wastewater lines shall not be located nearer than 5 feet from any tree.
- No wastewater line shall be located in alleys unless approved by the Director of Engineering.
- Wastewater mains deeper than 12 feet with service connections will require a second shallower parallel main to convey wastewater to the nearest downstream manhole.
- The minimum acceptable Manning's "n" value for use in wastewater design shall be 0.013. Pipes shall be placed on such a grade that the velocity is not less than 3.0 fps or more than 10 fps. Minimum and maximum pipe slopes using n = 0.013 shall be as follows:

TABLE 4-4 – GRADES FOR WASTEWATER MAINS

Pipe Diameter (Inches)	TCEQ Minimum Slope (Percent)	Desired Minimum Slope (Percent)	Maximum Slope (Percent)
6	0.50	2.00	12.35
8	0.33	0.76	8.40
10	0.25	0.56	6.23
12	0.20	0.44	4.88
15	0.15	0.33	3.62
18	0.11	0.26	2.83
21	0.09	0.21	2.30
24	0.08	0.17	1.93
27	0.06	0.15	1.65
30	0.055	0.13	1.43
33	0.05	0.11	1.26
36	0.045	0.10	1.12
39	0.04	0.09	1.01
>39	*	*	*

Slopes less than the City's desired minimum percent may be allowed only with approval from the Director of Engineering.

* Note: For pipes larger than 39 inch diameter, the slope can be determined by Manning's formula to maintain a flow velocity greater than 3.0 feet per second and less than 10.0 feet per second when the pipe is flowing full. Manning's formula is as follows:

$$V = (1.486 / n) * (R ^ 2 / 3) * (S ^ 1 / 2)$$

where:
- V = Flow velocity, feet per second
- n = Manning's roughness coefficient, dimensionless
- R = Hydraulic radius, feet (flow area divided by the wetted perimeter) (R = A / P)
- S = Pipe slope, feet per foot

Larger lines shall not flow into smaller lines unless approved by the Director of Engineering.

4.4 State Highway Alignment Criteria

No new lines will be allowed in the TxDOT right-of-way except for perpendicular crossings.

4.5 Depth of Cover for Wastewater Mains

The depth for the design of sewer mains shall be determined by providing a 2% grade for the lateral from the center of the house or building to the center of the proposed main and including an additional 2 foot drop from the finish floor elevation.

When establishing depth for proposed wastewater mains, engineer of records shall evaluate proposed street grades and anticipate the size of proposed storm sewers in unimproved areas. Future storm sewers should be at least 3 feet below the top of pavement. The proposed wastewater line shall be at least 2 feet below the bottom of the future storm sewer. Minimum cover shall be 4.0 feet. Any main with less than minimum cover shall be encased in Class "G" embedment and is subject to approval by the Director of Engineering.

The lateral within the right-of-way must have at least 3 feet of cover at its shallowest point. The engineer of record is responsible for insuring that sufficient depth and grade is maintained to serve all proposed and future building sites in the sewer shed.

The engineer of record shall consider the ultimate roadway elevations in determining the depth of cover. Additional depth of cover shall be required for future development and as directed by the Director of Engineering.

4.6 Manhole Locations and Manhole Sizes

Construct manholes at the following locations:

- At each end of lines that are installed for aerial crossings and siphons
- At the location of lateral connections that are 6 inch diameter or greater
- At the spacing indicated in Table 4-5

TABLE 4-5 – MANHOLE SPACING

Size of Wastewater Line	Manhole Spacing
Less than 16 inch diameter	500 feet
16 inch through 30 inch diameter	800 feet
36 inch through 48 inch diameter	1,000 feet
54 inch diameter and greater	2,000 feet

- At all locations where diameter of the pipe changes.
- At all locations where pipe material changes.
- At all locations where the horizontal or vertical alignment of the sewer main changes.
- At the beginning and end of horizontal curves.
- At the end of a wastewater collection system pipe that may be extended in the future. Provide pipe stub outs with plugs for future connections.

- Spacing between a manhole and an upstream cleanout shall be limited to 300 feet

A manhole shall not be located in the flow path of a watercourse, or in an area where ponding of surface water is probable. Additional manholes may be required as determined by the Director of Engineering.

4.6.1 Floodplains

In floodplains, watertight sealed manholes (Type S) with chimney seals shall be used to prevent the entrance of storm water. Where more than three manholes in sequence are to be bolted and gasketed, every third manhole shall be vented 2 feet above the fully developed 100-year floodplain elevation or 6 feet above the adjacent ground line, whichever is higher. The engineer of record shall obtain and provide the elevation of the fully developed 100-year floodplain. Sealed manholes shall also be used in all areas subject to carrying drainage flow or in drainage ways.

4.6.2 Manhole Lids and Rims

Manholes shall have a heavy duty (HS-20 loading), traffic bearing frame and cover manufactured by Bass & Hays Foundry or equal, and the reinforced concrete shall have a design strength of 4000 psi at 28 days. Manhole covers shall include the City of McKinney name and the City logo cast-in.

Manholes shall have inflow protection inserts, minimum thickness of 1/8 inch, made of HDPE meeting ASTM D 1248 Class A, Category 5, and Type 111. Insert shall include a lift strap and vent hole with vent disk as manufactured by Knutson Manhole Inserts, Parson Manhole Inserts or approved equal.

Rim elevations in non-paved areas shall be a minimum of 6 inches above grade.

4.6.3 Manhole Sizes

Manholes to be constructed on existing or proposed sewer lines shall be sized as shown in Table 4-6.

TABLE 4-6 – MANHOLE DIAMETER REQUIREMENTS

Pipe Diameter	Manhole Minimum Diameter
8 inch through 12 inch	4.0 feet
15 inch through 27 inch	5.0 feet
30 inch through 36 inch	6.0 feet

Manholes deeper than 15 feet shall be a minimum of 5 foot diameter. Manhole diameter may increase due to pipe geometry, excessive depths, and multiple pipes connected to the manhole. Special manholes shall be designed for mains larger than 36 inch diameter pipe and for mains greater than 15 feet deep. Eighteen inch minimum measured outside diameter to outside diameter of pipe along the outside surface of the wastewater manhole shall be maintained between pipes to manhole connections. If the 18 inch separation

cannot be achieved a larger diameter manhole shall be selected to meet these requirements.

Where pipes enter a manhole there shall be a minimum of 0.10 foot of drop between flow lines. Where unequal size pipes enter a manhole, crown of pipes shall match elevations.

4.6.4 Drop Manholes

Drop manholes shall be required when the inflow elevation is more than 24 inches above the outflow elevation. New drop manholes shall be constructed with inside drops with a 5 foot minimum diameter. Depending on the depth of the drop manhole, the Director of Engineering may increase the minimum diameter above 5 feet. When connecting to an existing 4 foot manhole outside drops will be allowed. Drop manholes shall increase in diameter as necessary to accommodate the pipe for an internal drop connection as necessary to provide 48 inches of clear space for construction and maintenance operations.

4.6.5 Interior Liner for Manholes

A protective polyurethane coating or equal shall be provided for:

- All wastewater manholes for 24 inch and greater line sizes.
- First wastewater manhole on line connecting to 24” or greater line.
- Force main transition manholes.
- All drop manholes.

Four types of manholes currently used by the City are listed below:

- Pre-cast
- Pre-cast with pre-cast base
- Cast in place
- Drop connection

Manufacturers

Manhole Frame and Cover

- Pamrex
- Bass & Hays Foundry

4.7 High Velocity Protection

The engineer of record shall provide special provisions to protect the pipe and embedment due to displacement of the bedding by erosion and/or shock due to velocities greater than 10 fps when flowing full.

4.8 Creek Crossings

Wastewater lines constructed under or over any flowing stream or semi-permanent body of water, such as a marsh or pond, shall be installed inside a separate watertight encasement pipe. Wastewater lines shall have manholes on each side of the crossing.

The engineer of record shall determine the type and limits of any special embedment, and specify the limits for specialized backfills to prevent soil erosion at the areas of trench backfill as approved by the Director of Engineering.

Bank stabilization shall be provided for existing creek and ditch embankments disturbed by construction operations in accordance with the latest edition of the Streambank Stabilization Manual prepared by Halff Associates, Inc., dated June 1998 and as approved by the Director of Engineering.

4.8.1 Inverted Siphons

For creek or channel crossings or under special design conditions, design of inverted siphons should be evaluated to verify if the location meets the design criteria and the requirements for an inverted siphon. Design calculations including the average and peak flows and the contributing basin area map (similar to a Drainage Area Map) for the design and operation of the siphon shall be submitted for review by the Director of Engineering.

Manholes/Junction structures are required at each end of the siphon with adequate clearance for rodding and maintenance operations.

Sag pipes must include two or more barrels, a minimum pipe diameter of 6 inches, and the necessary appurtenances for convenient flushing and maintenance.

Sufficient head and pipe sizes must assure velocities in the primary barrel reach at least 3 feet per second at least once per day using the average daily flow demand when the wastewater line is placed into service. Additional barrel(s) will convey the peak flows.

The arrangement of inlet and outlet details must divert the normal flow to one barrel. The system must allow for any barrel to be taken out of service for cleaning.

Provisions shall be provided to allow cleaning across each bend for operations and maintenance.

Sag pipe shall be designed to meet TCEQ Chapter 217

4.8.2 Aerial Creek Crossings

Aerial crossings may be used only when all other alternatives have been evaluated and rejected.

The engineer of record shall use steel encasement pipe or ductile iron pipe around all aerial carrier pipes. The carrier pipe shall be restrained or welded all around joints or be a monolithic pipe between a span section. A span section must withstand the hydraulic forces applied by the occurrence of a 100-year flood including buoyancy. Both the aerial crossing encasement pipe and the supporting structure shall be capable of withstanding impacts from debris and water. A scour analysis report prepared by a geotechnical professional engineer shall be submitted to the Director of Engineering for review.

Wastewater lines shall have manholes on each side of the crossing.

The pier spacing for the aerial crossing supports must maintain adequate grade, and span the 100-year floodway. The design shall be performed by a Professional Structural Engineer licensed in the State of Texas.

Aerial crossings that parallel an existing aerial crossing shall be provided with adequate separation (20 feet minimum) to allow for maintenance and repair operations for the crossings.

4.9 Pipe Material

The specification of pipe material is the responsibility of the engineer of record based on the analysis of specific site, soil conditions, loading conditions, and pressure requirements. The following guidelines are based on pipe size only and in no way relieve the engineer of record of the responsibility of pipe material specifications applicable to the particular job and restrictions due to special construction methods.

TABLE 4-7 – PIPE MATERIALS FOR GRAVITY LINES

Internal Diameter Pipe Size	Pipe Material
4 inch through 15 inch	• PVC AWWA C900, minimum DR 18 • PVC SDR 35 or 26 (ASTM D3034) • Ductile Iron AWWA C151 Pressure Class 350 (internal ceramic liner and polyethylene encased). Ceramic liner to be manufactured by Protecto 401 or approved equal. • For water and wastewater separation deficiencies – PVC Pressure Pipe Class 160 SDR 26 (ASTM D2241) or Ductile Iron AWWA C151 Pressure Class 350 (internal ceramic liner and polyethylene encased). Ceramic liner to be manufactured by Protecto 401 or approved equal.
18 inch and larger.	• Solid Wall PVC ASTM F 679 • Fiberglass Reinforced Pipe (FRP) is acceptable for 24 inch diameter and larger lines. FRP with recommended Structural Number (SN) and Pressure Class Number (PN) manufactured by Hobas pipe, Ameron or Flowtite. Documentation shall be provided by the manufacturer indicating a minimum of 2 years of successful production of FRP in the US. • For water and wastewater separation deficiencies (18 inches) – PVC Pressure Pipe Class 160 SDR 26 (ASTM D2241) or Ductile Iron AWWA C151 Pressure Class 350 (internal ceramic liner and polyethylene encased). Ceramic liner to be manufactured by Protecto 401 or approved equal. • For water and wastewater TCEQ separation deficiencies (larger than 18 inches) –FRP with recommended Structural Number (SN) and Pressure Class Number (PN) (150 psi min.) manufactured by Hobas pipe, Ameron or Flowtite. Documentation shall be provided by the manufacturer indicating a minimum of 2 years of successful production of FRP in the US.

30 inch and larger	• Solid Wall PVC ASTM F679 • FRP with recommended Structural Number (SN) and Pressure Class Number (PN) manufactured by Hobas pipe, Ameron or Flowtite. Documentation shall be provided by the manufacturer indicating a minimum of 2 years of successful production of FRP in the US.

Note: For trench depths greater than 12 feet or other dead and/or live loading considerations, the engineer of record shall provide a pipe with the appropriate SDR rating which shall exceed the minimum requirements. The Director of Engineering may issue written approval for use of Ductile Iron AWWA C151 Pressure Class 350 (internal ceramic liner and polyethylene encased). Ceramic liner to be manufactured by Protecto 401 or approved equal.

Additional specifications for the above referenced pipes are as follows:

- **Ductile Iron Pipe -** All buried metal shall be wrapped polyethylene tube wrap.
- Different pipe materials are not allowed between manholes.
- The material used for the wastewater shall be designed for a minimum structural life cycle of 50 years. If the pipe material will deteriorate when subjected to corrosive conditions, the engineer of record shall provide for an acceptable corrosion resistant liner or provide calculation and data that demonstrates that the design and operational characteristics will provide for the minimum life cycle.
- All gravity sewer pipes shall be green in color. PVC fittings may be either green or white in color. Exceptions for the color requirement will be granted for RCP or Hobas piping, provided the pipe is adequately marked by an approved buried tape.
- Force main wastewater pipe refer to Section 5.7 Force Main.

4.10 Pipe Embedment

The type of embedment and backfill for sewer mains shall be NCTCOG Class “H” embedment extended to 12 inch minimum over the top of pipe.

Trench Dams may be required by the Director of Engineering depending on the ground water potential, pipe slope and length of sloped line segments.

4.11 Sewer Service

The sizes and locations of laterals shall be designated as follows unless otherwise directed by the Director of Engineering:

4.11.1 Single Family Residential

- Lateral size shall be 4 inch minimum at a 2% minimum grade for each lot or unit.
- One lateral per lot or each unit. Duplexes shall have two 4 inch laterals that shall be independently attached to the main.
- Laterals shall be installed at the center of the lot or duplex unit and shall have a minimum horizontal separation of 10 feet from the water service.

- All residential sewer services shall be extended to a point 10 feet beyond the property line at a maximum depth of 5 feet. Cleanouts shall be placed at the ROW/property line for all services. The service shall then be extended at a 45° angle to 4 feet above the finished grade and capped. When the lateral is extended, the extension will start at the street side of the 45° angle and extended to the structure.
- When connecting to new or existing lines, the use of boots or outside taps will not be permitted.

4.11.2 Multi Family Residential

- Lateral size shall be 6 inch minimum at a 2.00% minimum grade.
- A minimum of 1 lateral per building shall be required.
- Laterals shall have a minimum horizontal separation of 10 feet from the water service.

4.11.3 Non-Residential

Local Retail and Commercial:

- Lateral size shall be 6 inch minimum at a 2.00% minimum grade.
- A minimum of 1 lateral per building shall be required.
- Laterals shall have a minimum horizontal separation of 10 feet from the water service.

Manufacturing and Industrial:

- Lateral size shall be 8 inch minimum at a 0.76% minimum grade.
- A minimum of 1 lateral per building shall be required.
- Laterals shall have a minimum horizontal separation of 10 feet from the water service.

All residential sewer services shall be extended to a point 10 feet beyond the property line at a maximum depth of 5 feet. Cleanouts shall be placed at the ROW/property line for all services. The service shall then be extended at a 45° angle to 4 feet above the finished grade and capped. When the lateral is extended, the extension will start at the street side of the 45° angle and extended to the structure.

When connecting to new or existing lines, the use of boots or outside taps will not be permitted.

4.12 Cleanouts

Residential cleanouts located on service laterals shall be 4 inch diameter and located on the property line / right-of-way line.

Cleanouts on residential sewer services are to be located and installed as per approved drawings, building code requirements and City of McKinney Standard Details.

A clean-out with watertight plugs may be installed in lieu of a manhole at the end of a wastewater collection system pipe if no extensions are anticipated, if the cleanout is 300 feet or less from the downstream manhole. Cleanout installations must pass all applicable testing requirements outlined for gravity collection pipes in TCEQ §217.57 Testing Requirements for Installation of Gravity Collection System Pipes.

Cleanouts may be used on main lines within single family development at the end of lines only.

Cleanouts shall not be used on City maintained collection systems for multifamily, commercial and industrial development.

Cleanouts shall be provided on laterals with locator pad and tape to surface at the property line.

4.13 Connections to Existing Wastewater Mains

When connecting a 6" or larger new line to an existing wastewater line the engineer of record shall provide a new manhole at the point of connection. Prior to breaking into the existing line the new manhole and upstream pipe segment shall pass inspection by the Director of Engineering.

4.14 Abandonment of Wastewater Lines

The engineer of record shall specify on the plans the limits and appropriate conditions for abandoning existing wastewater lines that are to be replaced by the construction of proposed wastewater lines.

The engineer of record shall ensure that the laterals tying into the existing sewer line to be abandoned are transferred to the new main so a live sewer main is not abandoned. If a manhole on the sewer main being abandoned is to remain in service because other sewer mains are entering this manhole, then the sewer main to be abandoned shall be plugged inside the manhole. A note on the plans showing which sewer main is to be plugged inside the manhole is required.

All abandoned wastewater and force main lines shall be cut and plugged and all void spaces within the abandoned line shall be filled with grout, flowable fill or an expandable permanent foam product.

4.15 Lift Stations

Where possible, subdivisions will be laid out so that all wastewater lines will be gravity flow lines. If the use of a wastewater lift station is approved by the Director of Engineering, it shall be designed in accordance with Section 5 Wastewater Lift Station Design Requirements.

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SECTION 5 WASTEWATER LIFT STATION DESIGN CRITERIA

5.1 General

Lift stations shall be designed as permanent installations. Lift stations shall be designed to exceed the minimum requirement established in TCEQ Chapter 217.59 Lift Station Site Requirements and the requirements of this section. Lift stations will only be allowed after all other alternatives for transporting wastewater flows have been investigated and the lift station is found to be the best alternative for the service area. The Director of Engineering reserves the right to review each proposal and determine whether there is enough merit to justify a lift station.

5.2 Preliminary Design Submittal

A preliminary design submittal will be required for each lift station proposed. The submittal shall include a typed report, plans and a basin map prepared by a registered professional engineer.

5.2.1 Report

The typed report shall include the following information at a minimum:

- A brief summary of project scope that includes:
    - General description of proposed development
    - General explanation on circumstances that warrant a lift station including other options considered.
    - Description of any potential phasing of lift station until sewer basin is built-out.
- Influent hydraulic calculations showing:
    - Area in acres of the sewer basin and the development.
    - The area of each proposed use for the development and the ultimate projected use for the basin.
    - The average design flow and the maximum peak flow for the basin and the development.
    - Elevation of the proposed lift station site.
    - The elevation of the proposed discharge point of the force main.
- Preliminary wet well volume calculations
- Preliminary force main size with proposed velocities in pipe.
- Power outage records on Electric provider letterhead for power outages in area for the past 24 months.
- Opinion of probable costs for lift station, force main, and annual operating and maintenance costs.
- Ground water levels in proposed site area.
- Proposed system’s effect on existing system’s capacity.

- Odor control methods shall be submitted to the Director of Engineering for review and approval. The potential odor determination must include the estimated flows immediately following construction and throughout a system's 50-year expected life cycle.

5.2.2 Plans

The plan or plans submitted shall contain the following information:

- Scale
- North arrow
- Vicinity map
- Delineation of the boundary of the proposed development and offsite areas of the sewer basin (service area) in which the development lies. Basin delineation shall be provided using NCTCOG, LIDAR or surveyed contours. Contours shall be provided on 2 foot or less intervals. USGS topo is not permissible.
- Area in acres of the development and of the sewer basin contributing to the Lift Station.
- Proposed use or uses for the development and service area.
- The proposed lift station location.
- The proposed force main routing.
- Delineation of the 100-year Fully Developed flood plain, FEMA 100-year flood plain and Erosion Hazard setbacks.
- The location and size of the existing collection system at the tie-in point.
- Property lines.

5.3 Site Selection

The following are the minimum criteria that shall be met for a lift station site.

The station should be located as remotely as possible from populated areas. The lift station site shall not be located within 150 feet of an existing or proposed residential dwelling and 100 feet from a residential lot.

The station shall be protected from the 100-year flood and shall be accessible during a 100-year flood. The elevation of the site shall be a minimum of 2 feet above both the Fully Developed 100-year flood plain and FEMA 100-year flood plain.

The station site and its access shall be dedicated to the City as a wastewater easement. The fencing set back shall be 20 feet from the easement line to allow for a landscape and drainage buffer.

The station site shall be located so it may serve as much of the entire sewer drainage basin as possible. This may require that the station be located off-site of the development. When a station serves a larger area than the proposed development, the developer may enter into a pro-rata agreement with the City to be reimbursed the cost of excess capacity as other developments connect to the system.

5.4 Site Requirements

5.4.1 Access

Access will be provided by a concrete surface from a public street and/or dedicated access easement. Concrete shall be a minimum 6 inches thick, 4,000 psi reinforced concrete pavement with a minimum of 15 feet in width and 20 feet in length to allow maintenance vehicles to park fully outside of the City right-of-way designed in accordance with the City of McKinney's Street Design Standards.

Access drives shall be "T" shaped with applicable turning radii when located on existing and future thoroughfares and all other locations when pulling out becomes a safety hazard. The alignment of the drive shall allow maintenance vehicles the ability to back up straight to the wet well.

Access shall be functional during a 100-year flood. The access surface shall be a minimum of 2 feet above the water level caused by a 100-year return period storm.

5.4.2 Security

At a minimum, security of the lift station site shall be provided by an intruder-resistant fence (IRF) to restrict access by an unauthorized person(s). The IRF shall be placed around the perimeter of the site encompassing all interior structures and apparatuses and shall maintain a 3 foot clearance from all lift station components.

The IRF shall be a minimum of 8 feet high chain link fence with a 16 foot wide minimum slide gate for access. The IRF posts shall be schedule 40 hot dip galvanized steel and placed in concrete in 3 feet minimum depth holes. IRF fabric shall be hot dip galvanized 9 gauge steel. Black vinyl slats inserted in chain link fence shall be required when lift station is in open view of public.

5.4.3 Site Interior

Interior shall be a minimum 6 inches thick reinforced concrete pavement designed in accordance with The City of McKinney's Street Design Standards. Site shall be graded to drain away from the station to prevent storm water inflow or infiltration into the wet well. The wet well top elevation shall be a minimum of 6 inches higher that interior concrete to provide wheel stop for maintenance vehicles.

Control panel shall have a 3 foot minimum clear working area away from face of cabinet. Electrical and Instrumentation Panels shall be located where they do not obstruct vehicle access to the wet well or the dry well. They shall be placed at an elevation so that they are easily accessible.

A 15 foot high halogen area light with photometric cell on an aluminum pole shall be placed within 10 feet of wet well and control panel without obstructing daily operations.

Hoisting equipment shall be provided when the ultimate sized pump weight exceeds 2,500 lbs. Hoisting equipment shall be electric and capable of lifting selected pumps onto a 54 inch high truck bed or trailer with minimal manual assistance.

Provide a 1 inch potable freeze-proof water service with a 1 inch angle stop and double check valve shall be installed in an appropriately sized meter box.

5.5 Wet Well and Valve Vault Design

5.5.1 Wet Well Design

Wet well shall be cast in place or pre-cast watertight and gas tight walls with watertight joint meeting ASTMC478-90. Steel, fiberglass, HDPE and RCP are not acceptable materials. The tops may be pre-cast with the hatches built in. All wall penetrations through the wet well wall shall be gas tight. The wet well shall be hydrostatically tested to the top of the wet well for 48 hours prior to putting the lift station into service. Only losses due to evaporation will be tolerated. Additional design requirements are as follows:

5.5.1.1 Orientation

Orientation shall consider the routing of incoming sewer and force main for ease of maintenance and to minimize effluent turbulence.

Orientation shall allow a 5 ton vehicle to pull in forwards or backwards directly to the wet well or the dry well.

All influent gravity lines discharging into the wet well shall be located so that the invert/flow line is above the “on” setting liquid level of the pumps.

5.5.1.2 Level Sensors

Liquid level sensors shall be ENM-10 level regulators switch or approved equal. Sensors shall be provided for “All Pumps Off”, “Lead Pump On”, “Lag Pump On” and “High Level Alarm” levels as well as additional “Lag-Lag Pump On” for lift stations with more than two pumps.

Level Sensors shall be placed in a stilling well

5.5.1.3 Wet Well and Valve Vault Separation

Wet wells and valve vaults shall be separated by at least 1 foot and have separate entrances.

5.5.1.4 Liner and Coatings

Wet wells shall have a minimum of 10% sloped bottoms to the pump intakes and shall have a smooth finish to avoid excess sludge deposits.

Wet well interiors shall be coated with 2 coats of Tnemec Series 66 High-Build Epoxoline. Application shall be per manufacturer recommendation.

Wet well exteriors shall be coated with Tnemec Series 46H-413 High-Build Tnemec Tar. Application shall be per manufacturer recommendation.

5.5.1.5 Hatches

The wet well shall have a lockable odor suppressing aluminum door with an aluminum frame and safety grate. The minimum opening size shall be 4 feet x 6 feet with 2 doors large enough to adequately maintain the wet well. Door and frame shall be Bilco Type K, KD or an approved equal.

5.5.1.6 Ventilation

The design of a wet well must reduce odor potential in a populated area or as directed by the Director of Engineering.

Passive ventilation structures shall be provided and must include screening to prevent the entry of birds and insects to the wet well. An air vent pipe shall have a minimum diameter of 4 inches with outlet located 1 foot above wet well top.

Continuous mechanical ventilation structures shall be provided with ventilation equipment providing a minimum capacity of 12 air exchanges per hour and be constructed of corrosion resistant material.

5.5.2 Wet Well Volume

Wet well volume for a submersible pump station is the volume contained above the top of the motor, or as specified by the pump manufacturer.

High level alarm elevation shall be a minimum of 60 inches below the top of the wet well or 48 inches below the flow line elevation of the lowest service tap, whichever elevation is lower. Wet well volume shall be calculated by the following method:

$$V = \frac{T \times Q}{4 \times 7.48} \qquad \text{(Eq. 5-1)}$$

Where: V = Active volume (cubic feet)
Q = Pump capacity (gallons per minute, gpm)
T = Cycle times (minutes)
7.48 = Conversion factor (gallons/cubic foot)

Pump cycle time, based on **Peak flow**, must equal or exceed the following:

Pump Horsepower	Minimum Cycle Times
< 50	6 minutes
50-100	10 minutes
> 100	15 minutes

The operation cycle “T” shall not be less than 10 minutes minimum for Average flow and not more than 60 minutes for minimum flow conditions. The operation cycle time must exceed the manufacturer’s requirements.

5.5.3 Valve Vault

Valve vaults shall have sloped bottoms towards a floor drain to remove liquid build up. The floor drain line from the valve vault connecting to the wet well must prevent gas and liquids from entering valve vault.

The valve vault shall have a lockable aluminum door with an aluminum frame. The minimum opening size shall be 2 feet x 3 feet or large enough to adequately maintain the valve vault. Door and frame shall be Bilco Type K, KD or an approved equal.

5.6 Pumps, Lift Station Piping and Valves

5.6.1 Pumps

Stations shall contain a minimum of two pumps and shall be capable of handling peak flows with one pump out of service.

All pumps shall be explosion proof, non-clog, submersible type capable of passing a 2-1/2 inch diameter sphere or greater unless approved by the Director of Engineering.

Pumps shall be sized to operate at optimum efficiency. Minimum acceptable efficiency at the operating point will be 60%. The minimum required horsepower for the motor must be capable of handling the entire range as shown in the pump curve. Where necessary, a higher horsepower pump will be required to prevent any damage to the motor as a result of loss of hydraulic head situation.

All submersible pumps shall be equipped with an automatic flush valve attached to the pump volute using the hydraulic energy created by the pump operation to temporary suspend settled materials.

Manufacturer

- ITT Flygt submersibles or approved equal.

5.6.2 Pump Capacity

The firm pumping capacity shall be greater than the peak flow for the entire drainage basin. If the drainage basin is significantly larger than the proposed development and it is not feasible to design for this flow, the firm capacity may be designed to handle a portion of the basin with the ability to expand for the ultimate basin capacity with approval from the Director of Engineering.

The pump curves shall be selected so that during normal operating conditions the pumps will run near the best efficiency point. The curves shall not approach shut off head when the pumps are running together.

System head curves, pump curves and head calculations shall be submitted. Calculations and pump curves at both minimum (all pumps off) and maximum (last normal operating pump on) static heads, and for a C value of both 100 and 140 must be provided for each pump and for the combination of pumps with modified pump curves. Head calculations shall be the sum of static head, friction head in force main and lift station piping, and a fittings head.

Flow calculations, system curves and head calculations shall be shown in the construction drawings as well as in a final design report. Final design report shall include all of the preliminary design submittal requirements with the exception of the replacement of final design information.

5.6.3 Lift Station Piping

Piping inside the lift station shall be ductile iron meeting AWWA C151. All fittings shall be ductile iron meeting AWWA C110 or C151. Interior of the pipe and fittings shall be lined with American Polybond Plus, which consists of a primer layer of 5 mils thick fusion bonded epoxy and 55 mils thick of modified DuPont Fusabond Polyethylene, or approved equal.

All nut and bolt assemblies inside the wet well shall be ASTM 316 stainless steel unless otherwise specified.

Lift station piping shall be designed with an additional emergency pump connection, allowing the station to be operated with the primary pump(s) out of service for an extended period of time.

5.6.4 Valves

Isolation valves, check valves and air release/vacuum valves shall be located in the valve vault.

5.6.4.1 Isolation Valves

Each pump shall have one isolation valve downstream of the pump and check valve. Isolation valves shall be resilient wedge gate valves or plug valves meeting the City of McKinney standard specification.

5.6.4.2 Check Valves

Check valves shall be a controlled closing swing check valve with a lever arm or a ball check. There must be at least 15 feet of vertical head downstream in order to use a ball check valve.

Check valves shall be located upstream of the isolation valve.

All external nuts and bolts shall be ASTM 316 stainless steel.

5.6.4.3 Air Release/Vacuum Valves

Air release valves of a type suitable for wastewater service shall be installed along the force main where the force main would be prone to trapped air.

The type of valve shall be air release or a combination of air release and vacuum breaker. Valves shall be fitted with blow off valves, quick disconnect coupling and hose to permit back flushing after installation without dismantling the valve.

The engineer of record shall determine the valve type and location. The calculations for valve type and valve sizing shall be provided to the Director of Engineering.

Isolation valves for 3 inch and smaller air release valves shall be all bronze or brass. Isolation valves 4 inch and larger shall meet McKinney standard specification for resilient wedge gate valve.

Locations of the air release/vacuum valves shall be shown on the plan and profile sheets for the force main.

Manufacturers

Air Release and Vacuum Valves

- VENT-O-MAT Model RBX or approved equal

5.7 Force Main

Force main capacity shall be sized to meet the pump capacity. The force main may be designed to handle a portion of the basin with the ability to expand for the ultimate basin capacity with the approval from the Director of Engineering. The minimum force main size shall

be 4 inch diameter except for grinder pump lift stations. The minimum recommended velocity is 3 feet per second, and the velocity shall not be less than 2.5 feet per second when only the smallest pump is in operation.

Force main sewer pipe shall be designed to meet the working pressure requirements of the particular application. Design calculations and pipe selection shall be submitted to the Director of Engineering.

The force main must terminate below a manhole invert with the top of the pipe matching the water level in the manhole at design flow.

A force main must be designed to abate any anticipated odor.

TABLE 5-1 – PIPE MATERIALS

Internal Diameter Pipe Size	Pipe Material
4 inch through 12 inch	• **PVC AWWA** C900, minimum DR 18, minimum working pressure of 200 psi. • **Ductile Iron** AWWA C151 Pressure Class 350 (Lining shall be American Polybond Plus, which consists of a primer layer of 5 mils thick fusion bonded epoxy and 55 mils thick of modified DuPont Fusabond Polyethylene, or approved equal and the exterior shall be polyethylene encased).
12 inch and larger	• **PVC** AWWA C905, minimum DR 18, 235 psi pressure class. • **Ductile Iron** AWWA C151 Pressure Class 350 (Lining shall be American Polybond Plus, which consists of a primer layer of 5 mils thick fusion bonded epoxy and 55 mils thick of modified DuPont Fusabond Polyethylene, or approved equal and the exterior shall be polyethylene encased)

Note: For trench depths greater than 12 feet or other dead and/or live loading considerations, the engineer of record shall provide a pipe with the appropriate DR rating which shall exceed the minimum requirements.

All fittings shall be wrapped ductile iron in accordance with AWWA C110 or AWWA C153.

All valves and fittings shall be restrained with Mega-lug or approved equal. Joint material for PVC shall conform to ASTM F471.

Plans shall include plan and profile for the force main.

Force main shall have a minimum of 4 feet of cover and be laid to standard specifications for potable waterline.

Force main separation and design criteria from water lines and all other utility lines shall meet the minimum requirements from TCEQ chapter 217 (Design Criteria for Sewerage Systems) and Chapter 290 (Rules and Regulations for Public Water Systems).

All force main contractors shall furnish and install non-metallic pipe detector tape. The detector tape must be located above and parallel to the forcemain and bear the label “PRESSURIZED WASTEWATER” continuously repeated in at least 1-1/2 inch letters.

5.7.1 Embedment

The type of embedment for force mains less than 24 inches shall be NCTCOG Class “H” embedment extended to 12 inches minimum over the top of pipe.

Pipe sizes 24 inches and greater the embedment class shall be a function of the pipe material selected including dead and live load considerations provided by the engineer of record. The engineer of record shall submit calculations on the embedment selected for the particular pipe type.

5.8 Electrical Requirements for New Lift Stations

5.8.1 Code Information

The engineer of record shall consult with the City of McKinney Building Inspections Department for the latest NEC code requirements.

Allow a minimum of 3 feet in front of all enclosures to wet well openings for workmen standing space. Observe NEC Article 110 rules for working clearances around the electrical panels.

5.8.2 Electrical Supply

Electrical services to be 240 volt 3 phase or 480 volt 3 phase.

Where a single-phase power transformer is required, install a minimum 3 KVA transformer, fused on both the primary and secondary side.

Install a power phase monitor capable of protecting against phase loss, phase reversal, low voltage, and high voltage.

Power phase monitor shall have 2 sets of control or alarm contacts. One set used to disable the pump control circuit. The second set used to alarm the RTU of a power failure.

Install current transformer between the service disconnect and the rest of the electrical equipment to provide a means to monitor the complete station load. Terminate secondary leads on a terminal strip for connection to a future power usage monitor.

Install potential transformer to provide a 120 volt secondary voltage on all 3 phases. Terminate the secondary leads on a terminal strip for connection to a future power usage monitor.

All electrical power circuits to be protected by circuit breakers (versus fuses) where applicable. As a guide for single-phase circuits use; RTU 15 amp, Flow meter/record 15 amp, pump control circuit 15 amp, convenience outlet/flood light 20 amp.

5.8.3 Pumps

Thermal protection and moisture sending devices in submersible pumps are to be wired to disable pumps and/or control circuits.

Hand position on H-O-A switch shall be provided and will be capable of operating pump in the event of a complete failure of the level controller.

The required remote start/stop capability is to be provided by using RTU control module. Install interface relay between RTU contacts pump control circuit. RTU contact operating may be momentary action only.

Motor starters shall have a normally open auxiliary contact to be used for a pump run contact connected to the RTU.

Where submersible pump cords are to be installed in conduits, the conduits should be sized and installed to facilitate removal and re-installation of the pump cords.

5.8.4 Level

Liquid level sensors shall be ENM-10 level regulators switch or approved equal. Sensors shall be provided for "All Pumps Off", "Lead Pump On", "Lag Pump On" and "High Level Alarm" levels as well as additional "Lag-Lag Pump On" for lift stations with more than 2 pumps.

Mercury float switch is to be installed and wired as a low level emergency shut off in the event of a continuous pump run due to a level controller failure, pump control switch left in hand position, etc.

5.8.5 Site

Install a weatherproof 20 amp rated 120 volt convenience receptacle outside of the electrical control panel wired to a 20 amp circuit breaker.

A switch-operated floodlight shall be installed to illuminate control panel area at night.

5.8.6 Generator

Install a manual transfer switch between electrical service and electrical equipment along with an emergency generator receptacle (Appleton# ADJA 1033-150).

5.8.7 Controls

All control relays are to be octal 8 pin or 11 pin plug-in type where feasible.

Three laminated control drawings are to be provided.

All conduit between wet well and control panel shall be sealed airtight to prevent wet well gases from entering control panel.

Enclosures shall be mounted on an appropriately sized mounting structure. Mounting structure shall be constructed of 6 inches x 2 inches x 0.25 inches hot dip galvanized steel channel stock. Intersections shall be bolted, not welded with stainless steel fasteners. Aluminum or epoxy coated steel unistrut may be attached to the mounting structure to facilitate placement of enclosures. The legs of the mounting structure shall be set at 24 inch minimum below grade and be encased in concrete.

5.8.8 Monitoring

A spare conduit shall be installed between the pump control panel and the RTU enclosure for power usage monitor wiring (1 inch minimum).

5.8.9 SCADA

Modifications to the City of McKinney's existing SCADA system will be required with the addition of any new lift station. Contractor shall supply SCADA equipment per City of McKinney standards.

5.9 Emergency Provisions for Lift Stations

Minimum emergency provisions shall comply with TCEQ chapter 217.63 "Emergency Provisions for Lift Stations".