

CITY OF GRAND PRAIRIE

WASTEWATER DESIGN CRITERIA MANUAL

MAY 2024





Wastewater Design Criteria Manual
City Of Grand Prairie

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MEMORANDUM

To: Whom it may concern

From: City of Grand Prairie

Date: May 10, 2024

Subject: **Wastewater Design Criteria Manual (2024)**

This document has been prepared concurrent with the City of Grand Prairie's Wastewater Collection System Master Plan Update 2022 to provide for an update to the City's Domestic Wastewater and Lift Station Design Criteria 2015 Update, dated October 30, 2015. This 2024 Update is intended to ensure consistency with City planning of wastewater infrastructure requirements and City compliance with current regulatory requirements for all wastewater improvements initiated within the City.

Please ensure that the following updated design criteria are to be used on all projects in the City of Grand Prairie, along with the revised Wastewater and Lift Station Standard Details plan sheets.

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DOMESTIC WASTEWATER DESIGN CRITERIA

All proposed wastewater designs within the City of Grand Prairie must comply with the requirements outlined in the Texas Commission of Environmental Quality (TCEQ), 30 Texas Administrative Code (TAC) §217 Design Criteria for Domestic Wastewater Systems and those included in this document. This includes the requirement to submit a summary transmittal letter to TCEQ, per 30 TAC, Chapter 217.6.(d).

1.0 Planning and Projected Flow

The Engineer shall reference the latest City Wastewater Master Plan to ensure the adequacy of the proposed design is consistent with the latest planning information. Several variables help make up the calculation for projected flows. These include housing density (units per acre), population count (persons per unit), infiltration and inflow (I/I), and peaking factors based on calculated population. Standards for developing sewer design criteria may also vary depending on the flow characteristics the City wishes to achieve through its system. At a minimum, wastewater lines within the City of Grand Prairie shall be designed in accordance with the latest edition of the rules set forth by the TCEQ, 30 TAC §217 Design Criteria for Domestic Wastewater Systems; https://www.tceq.texas.gov/permitting/wastewater/plans/design-rules. Please also refer to the City's Wastewater Master Plan and compare to the following criteria for the recommended pipe sizing. Where the City's design criteria vary from the City's Wastewater Master Plan or TCEQ's design criteria, the more restrictive criteria shall be used. The City Director of Engineering and Utility Services or his/her designee shall make the final decision as to pipe sizing, in case of conflicts. For public improvements associated with Capital Improvement Projects, the Engineering Manager is normally the designee; for private development projects, designees normally include the Engineering Development Coordinators.

A wastewater capacity assessment is required upon new development or re-development to account for the gross areas to be served within the catchment or naturally occurring sewer drainage basin, inclusive of the existing areas served and the proposed areas to be served with new development to provide the basis for determining adequacy of existing infrastructure serving the sewer drainage basin and for determining the capacity for new proposed infrastructure to meet projected demands. All capacity analysis shall be analyzed based on fully developed conditions.

1.1 Wastewater Capacity Assessment:

1.1.1 Average Daily Dry Weather Flow (ADDF)

Provide information on the actual daily dry flow for the existing use when available. In the absence of historical flow data, all capacity analyses shall use the daily wastewater flow – gallons per person and other generally accepted parameters established by the City of Grand Prairie Wastewater Master Plan (WWMP). In the absence of available data in the WWMP, the TCEQ data identified below may be utilized to determine the Average Daily Dry-weather Flow (ADDF).

Where limited information is available, the wastewater design flow may be estimated using the following table, and in general, for the average flow rate calculations use 100 gallons / person / day (gpcd) in residential areas and 3,500 gallons / acre / day (gpad) in non-residential areas:

Table 1-1 Wastewater Design Flow Estimation with Limited Available Data

Source	Remarks	Average Daily Wastewater Flow (gal/person)
Single Family Residential	3.5 persons per home	100
Trailer Park (Transient)	3.5 persons per trailer	60
Mobile Home Park	3.5 persons per trailer	75
School	Cafeteria & Showers Cafeteria / No Showers	20 15
Recreational Parks	Overnight User Day User	30 5
Office Building	A facility must be designed for largest shift	15
Factory	Add process flow per facility	20
Hotel/Motel	Per bed	75
Restaurant	Per meal	10
Restaurant with bar or cocktail lounge	Per meal	12
Hospital	Per bed	500
Nursing Home	Per bed	100
Service station/convenience store	Per customer	5
Apartments	3 persons per apartment	100

Source (Modified): 30 TAC §217.32(a)(3): Design Flows

1.1.2 Capacity Demand Calculations:

For Low Density Residential (Single Family) use 6* dwelling units per acre.

For Medium Density Residential (Single Family) use 12* dwelling units per acre.

For Multi-Family Dwelling (apartments, condominium, etc.) use 24* dwelling units per acre.

** Minimum design requirements; The Design Engineer may increase the number at own discretion and as approved by the City Director of Engineering Services or designee.*

1.1.3 Inflow and Infiltration (I/I):

Inflow and Infiltration flow can be anticipated in all wastewater conveyances and may be obtained from the WWMP. In absence of this information from the WWPM, it may be estimated to be 500** gallons per day (gpd) per inch diameter of pipe per mile of pipe.

** This is only to be used for determining the pipe capacity and pipe size. Infiltration / Exfiltration tests shall be conducted in accordance with 30 TAC §217 Design Criteria for Domestic Wastewater Systems.

Example:
7,500 linear feet of 12-inch diameter pipe. Determine the amount of flow anticipated due to I / I:

$$I/I = \frac{(12) * (7{,}500\ LF) * (500\ gpd)}{5{,}280\ LF/mile} = 8{,}523\ gpd$$

Determining flow rates from industrial, commercial, and municipal developments vary depending on the type of use, service and / or product that will be provided to the community. It is recommended that each developer / owner for the proposed facilities provide specific flow rates based on the future development design. This information should be reviewed and approved by the City prior to completing the design of the supporting collection wastewater lines and appurtenances. For industrial / commercial areas that are undeveloped, a factor of 3,500 gallons per day per acre (includes Peak and I/I) should be utilized to calculate the flow for the initial design of system facilities, recognizing that later improvement may be required, should this estimate prove to be inadequate.

1.1.4 Peaking Factor:

Use the following equation to calculate the anticipate peaking factor for the planned development.

Harmon's Formula:

$$M = 1 + \frac{14}{4 + P^{1/2}}$$

M = Ratio of design flow to average flow (Peaking Factor) with upper limit of 4.0

P = Population (in thousands)

In absence of actual population data, the following table can be used to determine the minimum peaking flow.

Table 1-2 Wastewater Peaking Factors

Pipe Diameter (inches)	Peaking Factor	Depth of Flow
Less than 18	4.0	Full
18 to 30	3.75	Full
Larger than 30	3.5	Full

Peaking Factors may be evaluated by the Engineer based on known metering and flow data for the particular basin or area under design.

1.1.5 Flow Calculation for Pipe Design:

For proposed developments use the Ultimate Peak Wet Weather Flow for Proposed Developments equation presented below:

$$Q_{ult} = (number\ of\ units) * (persons/unit) * (100\ gpcd) * (M) + I/I$$

Example: *200 Unit Single-Family Developments*
1,200 LF of 8-inch sewer
2,300 LF of 12-inch sewer

$$P = 200 * 3.0 = 600\ or\ 0.6\ (thousands)$$

$$M = 1 + \frac{14}{4 + 0.6^{1/2}} = 3.9$$

$$Q_{ult} = 200 * 3.0 * 100 * 3.9 + \frac{(8 * 500 * 1{,}200) + (12 * 500 * 2{,}300)}{5{,}280} = 0.2375\ MGD$$

For undeveloped areas use the Ultimate Peak Wet Weather Flow for Undeveloped Land equation presented below:

$$Q_{ult} = (DAc) * (zoned\ units/acre) * (persons/unit) * (100\ gpcd) * (M) + I/I$$

DAc = Developable area in acres

For the zoned units per acre use the most current housing density based on designated zoning.

1.2 Sewershed Considerations for Upstream Areas

1.2.1 TRA Pipeline Connections:

The City receives wastewater conveyance and treatment service from Trinity River Authority (TRA). TRA's system includes pipelines managed by TRA that carry wastewater from the City of Grand Prairie as well as upstream TRA served cities. TRA is restrictive in allowing direct connections to TRA lines and requires the City, when such connections are being considered, to formally request a Point of Entry (POE) prior to connecting to TRA lines. TRA has a standard POE request for information packet which is required to be submitted to TRA by the City, prior to TRA's consideration. If a development project proposes a new connection to a TRA manhole, a request for TRA's standard POE request information should be requested from the City to guide the preparation of the information needed to allow the City to make this request on behalf of new development. TRA requirements in considering POE requests from City may include the provision of permanent flow metering.

1.3 Planning (Discharge Area) Maps:

Both off-site investigation and on-site investigation is necessary for planning any proposed development or expansion of the City's infrastructure.

Off-Site: Use a 1 inch = 200 feet map showing all the naturally occurring contributing areas within the sewer basin, designated with a chart showing the calculated areas, flows, and the pipe sizing calculations. Use the larger size incremental pipe, as specified below, to maintain the minimum cleaning velocity in the main.

On-Site: Use a 1 inch = 100 feet map showing all the contributing areas designated with a chart showing the calculated flows and the pipe sizing calculations. Use the larger size incremental pipe as specified below to maintain the minimum cleaning velocity in the main.

1.4 Design Flows:

1.4.1 Manning's Equation:

$$V = \frac{1.486 * R^{2/3} * S^{1/2}}{n}$$

V = velocity (fps)

A = cross-sectional area of pipe (ft^2)

P = wetted perimeter (ft) = πD

R = hydraulic radius (ft) = A/P

S = pipe slope (ft / ft)

n = Manning's roughness coefficient = 0.013

Manning's Equation can be rearranged to calculate the pipe diameter that will satisfy the full pipe design flow calculated in section 1.1.5. The design pipe diameter must be greater than the calculated diameter in order to provide additional capacity. Using Manning's coefficient of n = 0.013, the flowing equation can be used to size the pipe:

$$D = 3.1424 * \left(\frac{Q_{ult}}{S^{1/2}}\right)^{3/8}$$

D = pipe diameter (in)

Q_{ult} = ultimate wet weather flow (cfs)

For minimum and maximum pipe slopes, refer to Section 2.1.

1.4.2 Flow Capacity:

Calculate the flow capacity for the pipe flowing full and verify that the ultimate wet weather flow is lower than the pipe capacity based on the selected pipe diameter.

$$Q_C = V * A$$

Q_C = flow capacity for proposed pipe (cfs)

2.0 Pipeline Design

Design for any wastewater main should utilize Manning's Equation to determine characteristics for both partial and full pipe flow conditions. Most wastewater installations today require the carrier pipe to either be lined with a poly-type material or made of plastic or non-corrosive pipe material, which when new may exhibit low Manning's coefficient (n-value); however, as the pipes age and slime builds up on the interior of the pipes, the n-value increases. In addition, TCEQ Design Standards require that an n-value of 0.013 within the Manning's equation be utilized.

2.1 Minimum and Maximum Slopes:

In accordance with TCEQ, pipe slope must, at a minimum, provide a full-pipe velocity of 2.0 feet per second (fps) and not exceed 10.0 fps. The City of Grand Prairie's minimum full-flow velocity is 2.3 fps with a maximum of 10.0 fps.

The minimum pipe diameter for any public gravity wastewater collection main shall be 8 inches for maintenance and easy cleaning. Pipe diameters 6-inches or less are no longer allowed for new gravity wastewater mains.

The following table summarizes the maximum and minimum pipe slopes based on requirements for minimum and maximum pipe velocity of 2.3 fps and 10.0 fps, respectively, using the stated Manning's equation. Projects that begin on or after January 1, 2024, 10-inch pipes will not be allowed. Instead, 12-inch pipe shall be used.

Table 2-1 Minimum and Maximum Slopes for Various Pipe Sizes

Pipe Diameter (inches)	Minimum Slope (%)	Maximum Slope (%)
8	0.44	8.30
12	0.26	4.88
15	0.19	3.62
18	0.15	2.83
21	0.12	2.30
24	0.10	1.93
27	0.087	1.65

2.2 Acceptable Pipe Materials:

Acceptable pipe materials for gravity pipelines include Polyvinyl Chloride (PVC), Fiber Reinforced Plastic (FRP), and High Density Polyethylene (HDPE).

The use of these pipe materials requires the use of joints meeting the specified standards as listed in Table 2-2, as related to type of pipe and size of pipe.

Table 2-2 Pipe Materials for Gravity Wastewater Pipelines

Pipe Material & Specification	Applicable Pipe Size Range (inches)	Joint Specification
PVC SDR 35 (ASTM D3034)	8 to 12 ≤ 12' depth	Bell & Spigot (ASTM D3212)
PVC SDR 26 (ASTM D3034)	8 to 12 > 12' depth	Bell & Spigot (ASTM D3212)
PVC PS 115 (ASTM F679)	115 to 27	Bell & Spigot (ASTM D3212)
PVC SDR 26 (ASTM D2241) *	8 to 12	Bell & Spigot (ASTM D3139)
FRP (ASTM D3262)	18 and larger	Bell & Spigot (ASTM D4161)
FRP (ASTM D3754) *	18 and larger	Bell & Spigot (ASTM D4161)
HDPE DR 17 DIPS (ASTM F714)	8 to 48	Fusion (ASTM F2620)
HDPE DR 11 DIPS (ASTM F714) *	8 to 36	Fusion (ASTM F2620)

*Note: * Denotes pressure rated pipe. See Section 7.1 for design conditions requiring this type of pipes.*

Alternative pipe materials for gravity wastewater pipelines shall be accepted by the City Director of Engineering Services, or designee.

Force mains or pressure systems (such as inverted siphons) may require the use of other materials. In such cases, Ductile Iron Pipe, AWWA C150/A21.51 may be used. All ductile iron pipe and fittings shall have an interior ceramic epoxy liner and exterior ASTM A674 polyethylene encasement.

2.3 Depth of Cover:

The depth of cover is measured from the top of the pipe to the natural or finished ground surface above the pipe. The main must be deep enough to serve adjacent properties. The minimum depth of cover shall be 4 feet.

Table 2-3 Minimum Depth of Cover for Wastewater Mains

Pipe Diameter (inches)	Minimum Depth (ft)		
	Unimproved	Improved	Highway/Railroad Crossing
12 and smaller	6	4	6
15 and larger	7	6	6

The design of the pipe and embedment shall account for the maximum depth of cover.

2.4 Service Line Connections:

Service line connections are generally not allowed on large interceptors, except at manhole locations, because interceptors are generally buried deeper thus more difficult to access for repairs of tap connections. A shallower collection line will be required for collecting service connections, then discharged into an interceptor manhole, as necessary. All Developers and Engineers shall verify with City staff the alignment locations of all collection lines and interceptors to prevent negative impacts on future capital project improvements by the City.

Table 2-4 Wastewater Mains Classifications and Service Line Connection

Type of Main	Pipe Diameter (inches)	Direct Service Connection
Collection	Less than 18	Permitted
Interceptor	18 to 30	Not Permitted *
Large Interceptor	Larger than 30	Not Permitted

*Note: * Service connection may be allowed through a manhole upon approval from City Operations.*

2.5 Minimum Easement:

The minimum easement width required to install and maintain a single City wastewater main are summarized in the following table:

Table 2-5 Minimum Easement Width

Pipe Diameter (inches)	Depth of Pipe* (feet)	Minimum Width** (feet)
8 to 12	≤ 8	15
	>8	20
16 to 24	≤ 8	25
	>8	35
30 to 66	≤ 8	40
	>8	50
72 and larger	≤ 8	60
	>8	70

*Notes: * Depth of pipe shall be measured from the top of pipe to the ground surface.*
*** Pipe shall be centered in the easement.*

The minimum vertical clearance above the ground surface for any easement is 20 feet. This allows the typical backhoe to maneuver in the case where a repair is necessary and minimizes risk to both City and the party who is granting the easement. In limited instances, this vertical clearance can be reduced, provided construction plans cite the need to avoid conflicts, particularly with overhead electric (OHE).

The Engineer shall request a Surveyor to prepare a legal description (field notes) for the required easement. This request shall include, but not be limited to, the following information:

- Type of Easement: Permanent or temporary / construction
- Purpose of Easement: Water and / or wastewater easement
- Location Map: A map showing location of easement with coordinates and dimensions.

The legal description shall be submitted to the City for review and approval, as necessary. Easement preparation should conform to the minimum requirements from the Texas Board of Professional Engineers and Land Surveyors (TBPELS).

3.0 Field Investigation

Field investigations including Geotechnical Investigation, Subsurface Utility Engineering (SUE), Environmental Site Assessment, or Land Survey Investigation shall be conducted for wastewater main design as necessary or if requested by the City.

The design and construction of wastewater mains must account for the variability of the uncertain subsurface conditions, and the potential project cost associated with the variability.

This is especially critical on large projects or projects containing complex or difficult geotechnical problems where alignment and / or grade changes may be appropriate based on geotechnical recommendations.

3.1 Geotechnical Investigation:

A geotechnical investigation may be conducted prior to design and / or construction of a project. However, data from an earlier project design activity may be incorporated if sufficient and reliable for the current project, at the Engineer's discretion.

Soil borings should be spaced no greater than 500 feet with additional borings spaced closer to better define areas of inconsistent stratigraphy.

Boring locations should be within an offset distance of no more than twenty (20) feet from the centerline alignment of the wastewater main or at the location of the proposed structure.

3.1.1 Open Cut Construction:

Minimum trench depths shall be:

- Trench depth plus five feet for trenches up to ten feet deep.
- Trench depth plus ten feet for trenches from 10 to 25 feet deep.
- One and half times trench depth for trench greater than 25 feet deep.
- Bore an additional five feet if the last planned sample is in water-bearing sands.

3.1.2 Trenchless Construction:

Minimum boring depth shall be:

- Entry / exit pit depth plus five feet
- Pipe invert plus five feet

3.2 Subsurface Utility Engineering:

A Subsurface Utility Engineering (SUE) investigation process may be conducted in project planning, design, or construction phase(s) to obtain reliable subsurface utility information. Using SUE investigations may avoid utilities' relocation before construction or unexpected conflicts during construction; thereby eliminating many costly, time-consuming project delays. In addition, all existing utilities shall be located and marked prior to initiation of survey for design. SUE shall be conducted by well-trained, experienced, and capable individuals using state-of-the-art equipment, vacuum excavation or comparable non-destructive locating equipment, state-of-the-art surveying and other data recording equipment and software systems, as necessary.

Utility Quality Level (QL) attributes are described in "Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, CI / ASCE 38-02" by American Society of Civil Engineers (ASCE), Latest Edition. Accordingly, four (4) Quality Levels (QLs) of SUE can be conducted, as needed:

3.2.1 Quality Level D:

- Information derived from existing records or oral recollections.
- This work shall be conducted by the Engineer during the preliminary project planning.

3.2.2 Quality Level C:

- Information obtained by surveying and plotting visible above-ground utility features and by using professional judgment in correlating this information to Quality Level D.
- This work shall be conducted during the survey for design.

3.2.3 Quality Level B:

- Information obtained through the application of appropriate surface geophysical methods to determine the existence and approximate horizontal position of subsurface utilities.
- This work shall be performed to obtain horizontal location of subsurface utilities in areas with congested utilities (i.e., central business district), areas where utility information is sparse or where a specific utility of high importance is being crossed (i.e., gas line).

3.2.4 Quality Level A:

- Precise horizontal and vertical location of utilities obtained by the actual exposure and subsequent measurement of subsurface utilities, usually at a specific point.
- This work shall be performed to obtain precise horizontal and vertical locations of subsurface utilities in areas with congested utilities (i.e., central business district), areas where utility information is sparse or where a specific utility of high importance is being crossed (i.e., gas line).

3.3 Environmental Site Assessment:

The Engineer shall evaluate all available resources to identify any potential environmental issues, including possible soil or groundwater contamination, during the planning phase of wastewater main construction projects. The Developer or Engineer shall contact the City to determine if an Environmental Site Assessment (ESA) will be needed for the proposed project. If the project involves a property acquisition, a Phase I ESA from a qualified and experienced environmental consultant shall be requested. Federally funded projects generally require a Phase II ESA.

4.0 Manholes

4.1 Location:

Manholes shall be placed at:

- All points of horizontal or vertical changes in pipe alignments, grade, size and material;
- At intersection of all pipes;
- At the end of all pipes that may be extended in the future. Manholes placed at the end of a wastewater collection system pipe that may be extended in the future must include pipe stub outs with plugs;
- On each side of major stream crossing or at siphon crossings; and
- At all force main air release device and isolation valve locations.
- A manhole must not be located in the flow path of a watercourse, or in an area where ponding of surface water is probable.

Wastewater manholes shall be spaced as presented in the following table:

Table 4-1 Manhole Spacing Criteria

Pipe Diameter (inches)	Maximum Manhole Spacing (feet)
8 to 15	500
18 to 30	800
36 to 48	1,000
54 and larger	1,000 *

*Note: * Although TCEQ allows longer spacing for 54-inch diameter lines and larger, designs seeking longer distances require approval by the City Director of Engineering Services, or designee.*

Tunnels are exempt from manhole spacing requirements because of construction constrains.

4.2 Rim Collar:

All manholes installed in asphalt roads or unimproved areas (landscape, gravel, etc.) must include a concrete collar around the manhole frame and cover.

The concrete collar shall extend a minimum of 6-inches beyond the manhole frame and have a minimum thickness of 6-inches.

4.3 Manhole Sizing:

Manhole sizing is dependent up on the largest pipe size connected to the manhole. See Table 4-2 below:

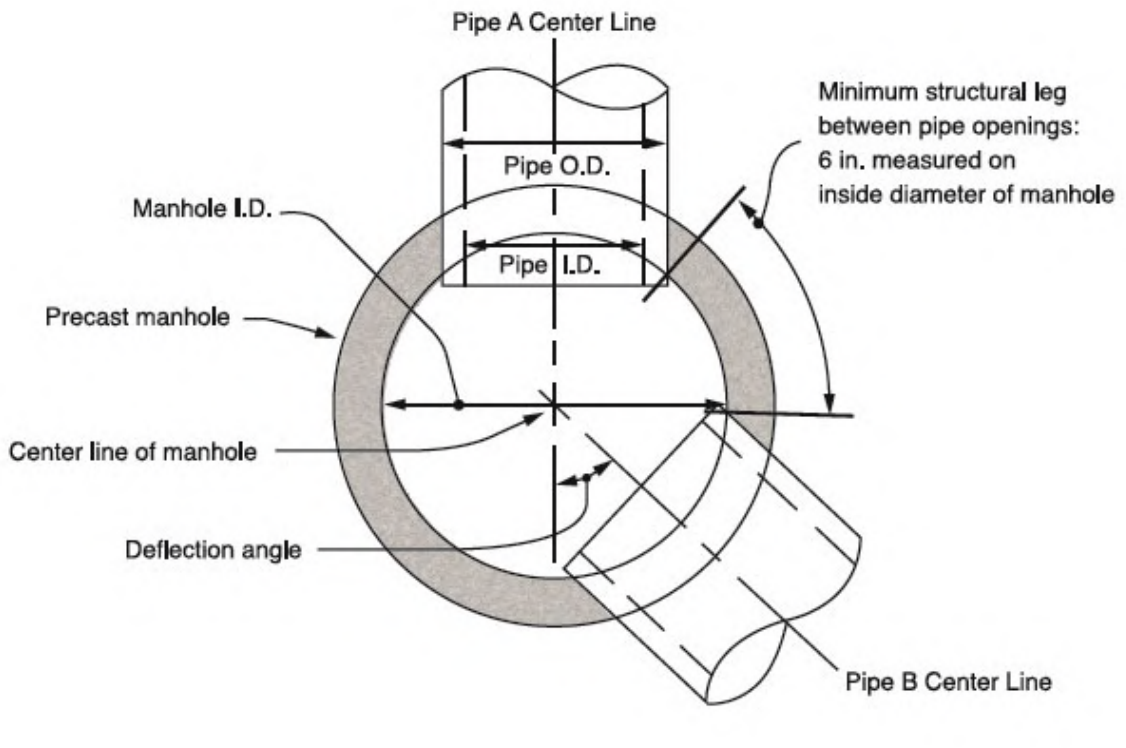
Table 4-2 Minimum Manhole Sizes

Pipe Diameter (inches)	Minimum Manhole Diameter (feet)	Minimum Deep* Manhole Diameter (feet)
8 to 15	4	5
18 to 30	5	6
33 to 48	6	As approved by City
48 and larger	As approved by City	As approved by City

*Note: * Deep manholes are defined as manholes where the distance from the rim to the lowest connected pipe invert is 10-feet or more.*

Where pipes connect to a manhole in acute angles (less than 90 degrees), the manhole size may be larger than listed in the table above, to provide a minimum of six inches of structural support width between pipes. The structural leg width is the inside curve length between the edge of two holes needed for pipe connection in a manhole, as illustrated in Figure 4-1.

Figure 4-1 Manhole Structural Leg



4.4 Venting:

Venting of the wastewater system is achieved by either passively allowing the air above the wastewater flow to have access in or out of the wastewater system connecting to external fresh air , or by actively extracting or forcing air into the system by mechanical means (e.g., fans). Typically, gravity collection systems rely on passive ventilation, whereas pressurized systems (wet wells at a lift station or discharge manholes at the end of force mains) may require mechanical ventilation.

The gravity wastewater system must be vented at a maximum spacing of 1,500 feet. For manholes located within the 100-year flood plain, vents shall extend three feet above the flood elevation to reduce risk from water inflow. Variances for proposed venting maximum distances, such as for extended lengths of trenchless sections, can be requested from TCEQ.

In locations where elevated hydrogen sulfide (H_2S) concentrations are expected, the venting on manholes should include a passive odor control canister. Activated carbon is an acceptable passive odor control substance.

In general, preferred locations for venting are manholes with pipeline connections result in a change in slope between incoming and outgoing pipes.

4.5 Drop Manholes:

Drop connection manholes are required where the difference between the invert of any influent pipe and the outflowing pipe is 24 inches or greater. Drop connections for new manholes shall be external to the manhole structure, with the piping and fittings must be encased in concrete or flowable fill. Existing manholes may have internal drop connections.

External drops shall be fitted with a two-way cleanout that allows for access of cleaning equipment to both the upstream pipe and the vertical drop pipe. The design of internal drops shall consider the size of the manhole and account for the clearance inside the manhole to allow for maintenance or repairs of the internal drop pipes.

4.6 Manholes in Floodplain:

All manholes placed within the 100-year flood plain shall be pressure type sealed manholes. When distances between manholes within the floodplain span up to 1,500 feet, venting must be provided, per Section 4.4.

4.7 Corrosion Protection:

Consider the potential for hydrogen sulfide generation within proposed and existing wastewater as result of the proposed design. Design the wastewater systems to minimize the generation and release of hydrogen sulfide as indicated in this section, and by use of Best Engineering Practices.

Design junctions in the collection system that to extent practical, provide smooth transitions and prevent the development of localized turbulence, which leads to the potential release of hydrogen sulfide from the wastewater.

Manhole invert channels must be designed to provide a smooth, curvilinear transition between incoming and outgoing pipes. Pipe connections to manholes shall be limited to 90 degrees or greater between any influent pipe and the outflowing pipe.

5.0 Wastewater Access Structures

5.1 Alternative Access Devices:

As an alternative to traditional wastewater manholes Poo Pit, Mini Pit, or Smart Pit, manufactured by Quick Stream Solutions, Inc., may be used instead of a manhole, if approved by the Engineering Director.

The maximum number of connected pipes is limited to two, with one influent lines and one effluent.

The maximum size of any connection to the Poo Pit is limited to 12-inches.

The requirements for alternative access devices regarding location (including spacing), rim collar, venting, drop connections, and floodplain location are the same as described for manholes in Section 4.0.

Wastewater access structure option may only be used for straight through access points and end runs. For drop connections 24-inches and greater, standard city manhole must be used instead.

6.0 Buoyancy Force

Buoyancy force calculations of sewers shall be considered for all projects within the floodplain and where groundwater existing within ten (10) feet of the bottom of the trench embedment. Buoyancy force calculation must be shown in the final plans if flotation of the pipe is an issue in the design. Anti-flotation design modifications shall be provided with appropriate construction methods where high groundwater conditions are anticipated.

Acceptable anti-flotation procedures include concrete collars on the pipe and increased pipe weight by increasing its wall thickness. For concrete collar design, use the weight of submerged concrete of 87.5 pounds per cubic foot. Provide calculations for review to the City Director of Engineering Services, or designee.

7.0 Pipeline Alignment

7.1 Separation Distances (Water Pipes):

The separation distance between water and wastewater mains, manholes, and other appurtenances is governed by 30 TAC §217 Design Criteria for Domestic Wastewater Systems and 30 TAC §290 Public Drinking Water.

Wastewater pipes shall be installed in trenches separate from trenches for water mains.

All proposed wastewater pipes, where possible, shall be installed below existing or proposed water mains. Where this is not possible, the requirements for crossing pipes in Section 7.1.2 shall be met.

All proposed wastewater collection facilities, where possible, shall have minimum clearance of nine feet from existing or proposed water lines in all directions. The nine feet distance shall be measured from outside surface of each of the respective facilities.

If the nine-feet separation is impractical, all wastewater pipes within nine feet of the water pipe must be designed as SDR 26 PVC (ASTM D2241) or equivalent Pressure Rated pipe (150 psi) and the following 30 TAC §217 Design Criteria for Domestic Wastewater Systems requirements must be met.

7.1.1 Parallel Pipes:

Where a proposed wastewater pipe parallels a water pipeline it must be located at least four feet horizontally and two feet vertically above the water pipe.

Where the vertical separation is impractical, the entire length of the pressure rated wastewater pipe within nine feet of the water pipe must be encased in a pressure rated (minimum 150 psi) pipe, at least two nominal diameters larger than the carrier wastewater pipe, sealed at both ends with cement grout or manufactured seal and supported by spacers every five feet.

7.1.2 Crossing Pipes:

Where a proposed wastewater pipe crosses under a new or existing water pipe it must have a vertical separation of at least six inches between the outside of the pipes. The crossing wastewater pipe must either be a pressure rated (minimum 150 psi) wastewater pipe measuring at least an 18-foot in length, centered at the crossing, with joints design to seal at atmospheric pressure, or the crossing pipe be encased in cement stabilized sand for at least 18 feet, centered at the crossing.

Where a proposed wastewater pipe crosses above a water pipe it must have a vertical separation of at least two feet between the outside of the pipes, and the entire length of the pressure rated wastewater pipe within nine feet of the water pipe must either be encased in a pressure rated (minimum 150 psi) pipe, at least two nominal diameters larger than the carrier wastewater pipe, sealed at both ends with cement grout or manufactured seal and supported by spacers every five feet, or the crossing wastewater pipe must either be a pressure rated (minimum 150 psi) wastewater pipe measuring at least an 18-foot in length, centered at the crossing.

7.2 Separation Distances (Storm Drain Pipes):

In the event a proposed wastewater line crosses a storm drain line, the wastewater line needs to be encased in concrete, per City Standard Details, for at least 5 feet in each direction from the outside diameter of the crossing. Steel casing pipe may be substituted in lieu of concrete or required in specific cases, to be considered by the Engineering and Utility Services.

Concrete encasement of wastewater lines that cross storm drains shall be required when the vertical separation between the outside edges of the crossing pipes is within the distances described in Table 7-1.

Table 7-1 Storm Drain Separation per Pipe Size

Minimum Separation between Storm Drain and Wastewater Pipes That Require Concrete Encasement (feet)	Storm Drain Pipe Diameter (inches)
2	24 or smaller
3	30 – 36
4	42 and larger

7.3 Casing Requirements:

Casing of a carrier wastewater pipeline is required when crossing TxDOT highways, railroad properties, crossing flood control levees, natural or manmade streams, and stormwater pipelines. Casing may be required if the City believes the property crossing dictates special care and protection for the pipeline. All casing pipes shall be steel casing or containment within steel liner plate, subject to the requirements of the property owner.

Pipe casing must be sized to allow for sufficient space to install spacers and insert wastewater pipe into casing pipe. The outside diameter of the wastewater pipe used for sizing shall be the greatest outside diameter of the pipe, such as bell, coupling, or other fitting that protrudes beyond the outside diameter of the barrel of the pipe. The typical sizing of casing pipes dictates that the casing pipe must be a minimum of two commercially available nominal diameters greater than the carrier pipe. The casing pipe thickness shall be per Table 7-2.

Table 7-2 Casing Pipe Requirements

Minimum Casing Thickness (inch)	Diameter of Casing Pipe (inch)
1/4 (0.2500)	12 or less
5/16 (0.3125)	>12 to 18
3/8 (0.3750)	>18 to 22
7/16 (0.4375)	>22 to 28
1/2 (0.5000)	>28 to 34
9/16 (0.5625)	>34 to 42
5/8 (0.6250)	>42 to 48
Special design with City Approval	>48

Concrete encasement of a pipeline is required when crossing streams or creeks for erosion protection from a distance behind the embankment to the same location after crossing behind the embankment on the opposite side.

For casing requirements at water pipe crossings, refer to Section 7.1.

7.4 Highway Crossings:

The design of wastewater mains within a Texas Department of Transportation (TXDOT) or North Texas Tollway Authority (NTTA) highway must be in compliance with all applicable requirements of TXDOT or NTTA, unless a variance is approved by TXDOT or NTTA. The following reference

applies: Title 43 of the Texas Administrative Code, Part 1, Chapter 21, Subchapter C – Utilities Accommodation.

For Private Development projects, the Developer's Engineer shall communicate with TXDOT or NTTA for preliminary approval. The Developer's Engineer shall provide documentation of TxDOT's preliminary approval to the City. Once the Engineer receives notification from the City that the construction plans are sufficient, the City will then create a TxDOT permit through TxDOT's Right of Way Utility and Leasing Information System (RULIS) for TxDOT review and approval, or other method per the governing district or entity. If rejected, the Developer's Engineer will be responsible for any design modifications as noted. The City will obtain the permit from TxDOT once approved.

For City Projects: The consulting engineer works with the Capital Improvement Engineer to request a TxDOT permit through the TxDOT's RULIS site. First, the CIP engineer reviews and accepts the design, it then may grant the consulting Engineer access to its TxDOT RULIS site. TxDOT then reviews the request and if it rejects it then the consulting Engineer will then discuss an alternative solution with City staff.

Wastewater mains shall be located to avoid or minimize the impact to future highway projects and improvements, to allow other utilities in the right-of-way, and to permit access to wastewater mains and other utility facilities for their maintenance with minimum interference to highway traffic.

New water and wastewater mains crossing a highway shall be installed at approximately 90° to the centerline of the highway.

New wastewater mains located longitudinally along a highway shall be designed parallel to the right-of-way.

All water and wastewater crossings shall be encased with steel casing pipe in accordance with Section 7.3, or approved equal. Casing pipe shall be extended to 5-feet pass the street pavement, or a distance as directed by TxDOT or the City.

Manholes and other appurtenances shall not be placed in the pavement or shoulder of highway.

7.5 Railroad Crossings:

The design of wastewater mains within railroad right-of-way must be in compliance with the requirements of the appropriate railroad authority. The designer should determine which railroad company right-of-way is being crossed and obtain their utility accommodation policies prior to beginning the design. The following references may be applicable:

- American Railway Engineering & Maintenance-of-Way Association (AREMA), Manual for Railway Engineering, Latest Edition.
- Utility Accommodation Policy by Burlington Northern Santa Fe (BNSF), Latest Edition.

New wastewater mains crossing a railroad shall be installed at approximately 90° to the centerline of the railroad. All wastewater crossings shall be encased with steel casing pipe or steel liner plate in accordance with Section 7.3, or approved equal. Casing pipe crossing railroad tracks shall be designed to withstand E80 railroad loadings and shall extend to the railroad right-of-way lines.

Casing pipe thickness shall be at a minimum as described in Table 7-2.

7.6 Aerial Crossings:

Aerial crossings shall be as per TCEQ and the City of Grand Prairie requirements to include the following:

Crossing shall be designed for the fully developed creek section as approved by the City.

Future erosion shall be addressed as part of the design. Any disturbed embankment areas shall be restored using a design to reduce the potential for subsequent erosion.

PVC pipe aerial crossings shall be steel encased; ductile iron material shall have an inside epoxy liner. Other pipe material shall be approved by the City Director of Engineering Services, or designee.

Piers shall be a minimum of 24-inch in diameter and embedded in adequate material to be determined by a Geotechnical Engineer in a report to be submitted to the City. The information shall be fully specified and shown on the plans and specifications. The casing pipe shall be sufficiently restrained to minimize movement due to all external forces exerted on said pipe.

8.0 On-Site Sewerage Facilities

On-site sewerage facilities are not allowed with the City of Grand Prairie or its extraterritorial jurisdiction (ETJ), unless approved by the Environmental Services Department at 972-237-8055.

9.0 Siphons

An inverted siphon can be designed for a portion of a wastewater main which dips below the hydraulic grade line to avoid any obstructions including, but not limited to a drainage structure, utility, tunnel, or stream. It shall only be considered where avoidance or adjustment of the obstructing utility or structure is not practical. All siphons shall be designed in accordance with the following criteria:

- Two or more barrels (pipes)
- All pipes shall be pressure rated type per Section 0, and may include ductile iron as the material selected
- A minimum pipe diameter of six inches
- The necessary appurtenances (inlet and outlet box access) for convenient flushing and maintenance
- One upstream and one downstream manhole or access structure for cleaning equipment, inspection, and flushing
- The structures shall be either constructed of corrosion resistant material (preferred) or have a corrosion resistant coating or liner on all interior surfaces.
- The siphon must be sized with sufficient head to achieve velocity of at least three feet per second at initial and design flows at least once per day for the siphon to be self-cleansing and to minimize siltation

- The inlet and outlet shall divert the normal flow to one barrel and divert overflow at higher flowrates to other barrels
- The system shall be designed to allow any barrel to be taken out of service for cleaning
- The system shall be designed to minimize nuisance odors
- All weather access roadway is required for maintenance vehicles.
- An air-jumper pipe shall be provided to connect the headspace of the upstream and downstream manhole, to reduce the potential for air binding, and ensure continuous ventilation of the wastewater system.

10.0 Streambank Stabilization

10.1 Stream Crossing:

The following items must be considered for a wastewater main crossing under a flowing stream or semi-permanent body of water such as a marsh or pond.

Minimize the number of crossings, the total length of the crossing, and the disturbed area. Try to select an alignment that is perpendicular to the stream flow.

Identify existing and potential long term channel instability problems at the alignment location, using available topographic maps, land use information and field investigation. Channel instability can lead to failure/erosion of channel banks, shifting of channel positions and channel bed erosion.

Selecting stream crossing locations. Avoid locations with severe channel instability problems. Crossing alignments may be strategically located to minimize the adverse effects of channel instability. The following are guidelines for selecting locations of stream crossings:

- Abrupt drop in channel bed, flow depth, riffles or localized scour holes indicate existing or potential channel bed instability. Alignment should not be placed near and not downstream of these locations.
- Where flow constriction occurs, e.g., due to bridge construction or channelization, the crossing should be placed upstream of the location of flow constriction, if possible.
- If possible, select the vertical alignment of gravity sewer to avoid the use of an inverted siphon.

Stream crossings shall include a manhole on each side of the crossing and a watertight encasement pipe spanning between the two manholes. The carrier pipe shall be supported by spacers or blocking to ensure uniform grade and be pressure rated type pipe.

Embedment for the entire length of the crossing (bank to bank) shall be cement stabilized backfill.

The minimum pipe cover depth is four feet between the bottom of the stream bed and top of carrier pipe. In case the minimum cover cannot be achieved, the proposed design of streambed stabilization must be submitted for approval by the City Director of Engineering Services, or designee.

10.2 Post Construction Stabilization:

Stabilize channel banks to provide protection against surficial erosion of bank materials, slope instability and lateral movements of stream channel at the location of the stream crossing.

10.2.1 Standard Design:

If the primary problem is surficial erosion and the maximum bank-full flow velocity is greater than 10 feet per second (fps), provide riprap stabilization of channel banks and size the riprap to withstand the resulting velocities. The maximum bank-full flow velocity can be estimated by applying Manning's Equation to a representative channel cross section and bottom slope. Provide calculations for maximum bank-full velocity estimation.

For lower velocities, the use of pervious armored surface to resist scour and shear forces shall be used to protect all areas of the crossing.

Provide a minimum six inches concrete cap in the stream bed of rock-bottom creeks.

10.2.2 Special Design:

If certain field conditions are considered to be not entirely applicable to the Standard Design, consider alternative methods of channel bank stabilization, which may include use of geotextiles or vegetation, high performance turf reinforcement mats, systems to directing flow path away from the banks, or other methods to reduce flow velocities. Provide calculations for maximum bank-full velocity estimation. The following conditions may require special design:

- Stream banks subject to potential risks of overall slope instability. Perform slope stability analysis and determine if such risks exist. Take a soil boring at the channel bank at a depth of at least three feet below the proposed invert elevation of the pipe.
- Channel banks that may be subject to direct impact of high flow velocities, or lateral movements, e.g., meandering channel bends or channel constrictions.
- Channel banks with existing bank slopes much steeper than the maximum 2:1 (H:V) slope.

11.0 Wastewater Lift Station Design Criteria

11.1 General Requirements

All wastewater lift stations, and force mains shall be designed strictly in accordance with 30 TAC § 217.59-69 while meeting or exceeding the following design criteria.

11.1.1 Preliminary Design Report:

A Preliminary Design Report (PDR) sealed by a Texas PE must be submitted to the City for review for all proposed lift station designs. The PDR shall discuss the lift station justification including options considered (e.g., feasibility analysis of gravity conveyance), wet well and pump sizing, site analysis, odor control, emergency power, force main alignment, capital costs and operation costs.

Lift stations will only be considered a viable option if the cost-effective analysis clearly shows that the gravity solution is not economically feasible.

Lift station design shall consider the potential for future expansion to build out densities. The design of lift stations shall incorporate a wet well sized for the final capacity of the lift station.

Lift stations can be phased construction if accepted by the City.

Lift stations must be located and sized so they can serve as much of the entire wastewater drainage area as possible. This may require that the lift station be located off-site from the developed area.

11.2 Lift Station Site Layout

11.2.1 Layout:

Lift Station site layouts shall consider clearances for unimpeded maintenance operations. The area surrounding the lift station components including, but not limited to, the wet well, pump and motor slabs, structural support for valves if separate from lift station, generator, electric service rack, shall be large enough to permit heavy equipment and vehicles ample room to maneuver. The lift station site shall be designed to allow maintenance vehicles to have direct access to the wet well, electric controls, generator, and bypass facilities.

11.2.2 Flood Protection:

The lift station site, including all electrical and mechanical equipment, shall be located, and protected from a 100-year flood event and remain fully operational during such event. Provide a letter dated, signed, and sealed by a Texas Professional Engineer certifying the site is protected from such an event. Include floodplain map and elevations to the design plans for approval.

11.2.3 Access and Pavement:

All lift stations shall have a permanent access road located in a dedicated right-of-way or permanent easement. The access road surface shall have a minimum width of 16 feet and the pavement shall meet AASHTO HS 20-44 standard. Crushed stone, flexible base or similar materials are not considered “permanent all weather materials.” A temporary access road pavement design will be considered on a case by case basis by City Director of Engineering

Services, or designee, but a permanent design must also be provided. The access road surface shall be designed to be above the water level caused by a 25-year storm event.

The sites for lift stations (50 horsepower (HP) and larger) shall be completely paved inside the fenced perimeter and have adequate turnaround capabilities for tanker truck or vac-truck to safely turn around. The pavement section shall be reinforced concrete pavement, meeting the AASHTO HS 20-44.

11.2.4 Water Supply:

Design shall provide for ¾-inch diameter minimum freeze-proof potable water service with hose bib vacuum breaker attached to the hose connection. It shall be located within 20-foot radius of wet well.

11.2.5 Odor Control:

The design of all lift stations must minimize potential odors. All lift stations must address the potential of odors and provide measures to mitigate hydrogen sulfide generation in force mains and wet wells. Odor control recommendations will be reviewed on a case-by-case basis based upon the specific location and age of the wastewater. Odor control equipment shall be located in an area where it can be serviced easily.

11.2.6 Additional Requirements:

Lift stations greater than 50 HP are required to program space (inside or outside of fenced area) for a transformer pad, with street access by the electrical provider for the area.

The lift station site shall be located as remotely as possible from residential development.

The force main served by the lift station shall be designed to limit peaks and valleys along the alignment and in no cases should the elevation of the force main be designed to be below the exiting elevation of the pumps (e.g., no pumping downhill). Also, FM design needs to eliminate any siphon potential unless accepted by the City.

Security area lighting must be provided with dusk till dawn photo-cell feature. Overhead lighting focused on the wet well should be provided.

All exposed pipe, valves, and fittings outside the wet well shall receive a 100% solids epoxy coating system with a coat system of urethane, suitable for the environment after installation. PVC is not acceptable as an exposed pipe material.

All pump discharge pipe and fittings within wet well, shall be ductile iron (4-inch and larger) or stainless steel SS 316. PVC piping will be acceptable for pipe sizes smaller than 4 inches. If allowed by City Director of Engineering Services, or designee, ductile iron pipe and fittings within the wet well shall receive protective coating and linings acceptable to the City. All accessory hardware in the wet well including but not limited to chains, cables, bolts, nuts, fasteners, brackets, anchor bolts, washers, cable holders and slide rails, shall be minimum 316 stainless steel.

A lift station pump must operate automatically, based on the water level in a wet well. The location of a wet well level instrument must ensure that the level monitoring is unaffected by currents, rags, grease, or other floating materials. A level instrument must be accessible without entering the wet well.

If used, motor control centers must be mounted at least 4.0 inches above grade to prevent water intrusion and corrosion from standing water in the enclosure.

Electrical equipment and electrical connections in a wet well or a dry well must meet National Fire Prevention Association 70 National Electric Code explosion prevention requirements and NFPA 820.

Electric service poles shall be located within lift station sites at a location where electric overhead wires do not cross over the lift station site. Locate service poles as indicated in Standard Drawings preferably; alternate locations must be evaluated with the City. Service poles must be located 20 feet away from the SCADA tower structure.

11.3 Wet Well Design

11.3.1 Dimensions:

The minimum wet well design will be 72 inches in diameter; a larger diameter may be necessary to accommodate submersible pumping equipment, piping, supports, emergency storage volume and to support pump cycle times. Depth of wet wells shall consider, but not be limited to all the following: emergency storage volume and adequate submergence of submersible pumps.

11.3.2 Configuration:

A wet well must be enclosed by watertight and gas tight walls and cover. The wet well cover shall have appropriately configured and sized openings for accessing and removing each pump from directly above pump and have fall protection. The opening size shall account for space requirements for fall protection systems. Any penetration through the walls of a wet well must be gas tight. A wet well must not contain equipment requiring regular or routine inspection or maintenance, unless inspection and maintenance can be done without staff entering the wet well. The influent gravity line discharging into a wet well must be located so that the invert elevation is above the liquid level of a pump's "on" setting. The lift station operation should not use the storage capacity of the collection system for its routine operation, unless accepted by the City Director of Engineering Services, or designee.

Valves are prohibited in a wet well. All valves shall be located in a separate watertight valve vault next to a wet well. All valve vaults shall have a cover to protect against the weather and shall have an aluminum access hatch opening for accessing each valve assembly.

A floor drain from the adjacent valve vault to a wet well must prevent gas from entering a valve vault by including flap valves, "P" traps, submerged outlets, or a combination of these devices.

11.3.3 Volume:

The wet well volume shall be calculated based on the projected final peak flows. The minimum operating volume of a wet well can be determined by the following method:

$$V = \frac{T * Q}{4 * 7.48}$$

V = Active Volume, ft^3

Q = Pump Capacity, gpm

T = Cycle Times, minutes

7.48 = Conversion Factor (gallons / ft^3)

11.3.4 Pump Cycle:

Pump cycle time, based on peak flow, must equal, or exceed those in the following table:

Table 11-1 Pump Cycle Time

Pump Horsepower	Minimum Cycle Times (minutes)
< 50	6
50 to 100	10
> 100	15

11.3.5 Wet Well Floor:

The wet well floor shall be sloped 10% to the pump intakes and have a smooth finish in order to become a self-cleaning wet well. There shall be no wet well projections that will allow deposition of solids under normal operating conditions.

11.3.6 Concrete Wet Wells:

Construction of concrete wet wells shall include a full monolithic structure or a precast wet well structure with monolithic base. The Engineer shall evaluate the thicknesses of the wet well wall and slabs, but the following thicknesses shall be met as minimum:

- Wet well wall thickness: 10 inches
- Wet well base slab: 12 inches
- Wet well top slab: 10 inches

Concrete wet well interior surfaces shall have a protective coating such as Warrens coating or Chesterton coating or approved equal applied to concrete surfaces, as accepted by the City.

11.3.7 Access and Maintenance:

All lift station configurations shall incorporate access to the equipment for hoisting or crane removal of pumps, motors, valves, etc. The City will determine if permanent hoisting equipment or a crane shall be included in the lift station design, depending on size of equipment. In general, when the largest pumping unit weighs more than 1,000 pounds, then an overhead crane will be required. When the largest pumping unit weigh less than 1,000 pounds, then a portable hoist will be required. The hoisting equipment must be acceptable and accepted by the City.

11.4 Lift Station Pumping Equipment Design

11.4.1 Types of Lift Pumps

All wastewater lift stations' pumps shall be submersible non-clog, capable of passing a minimum of a 3-inch sphere. Other lift station designs using centrifugal pumps with wet pit/dry pit configuration, suction lift pumps or package type lift station designs, will be considered on a case-by-case basis. A submersible pump must use a rail-type pump support system with manufacturer-approved mechanisms designed to allow personnel to remove and replace any

single pump without entering or dewatering the wet well. Submersible pump rails and lifting chains must be constructed of 316 stainless steel.

Grinder pumps will only be allowed on private lift stations, where maintenance is conducted by private entities. No grinder pumps are allowed on City owner or operated lift stations.

11.4.2 Pumping Design

All lift stations shall contain a minimum of two pumps and shall be capable of handling peak flows with one pump out of service. Each pump should have its own discharge pipe feeding into one common header.

The firm pumping capacity of a lift station must handle the expected peak flow. The firm capacity is defined as the capacity of the lift station with the largest pump out of service. Lead pump shall alternate at each pump cycle.

Table 11-2 Number of Pumps Based on Flow

Peak Daily Flow (gpm)	Minimum Number of Pumps
500 or less	2 Pumps: 1 Lead & 1 Standby
501 – 1,200	3 Pumps: 1 Lead, 1 Lag & 1 Standby
1,201 – 3, 000	4 Pumps: 1 Lead, 2 Lag & 1 Standby
Over 3,001	5 Pumps: 1 Lead, 3 Lag & 1 Standby

11.4.3 Drives:

Variable Frequency Drive (VFD) motor assemblies are preferred but their exclusion will be considered on a case-by-case basis by the City. If VFDs are not provided, City will consider Constant Speed Pumps. For lift stations with pumps and motors assemblies larger than 50 HP, the Engineer must compare using VFD to fixed-speed motor assemblies to evaluate the benefits for more flexible pumping capacity to the increased capital cost and O&M cost.

11.4.4 Pump Head Calculations:

A pump shall be selected based upon analysis of the system head and pump capacity curves that determine the pumping capacities alone and with other pumps operating.

The pipe head loss calculations, using the Hydraulic Institute Standards, pertaining to head losses through pipes, valves, and fittings, must be considered.

The selected friction coefficient (Hazen-Williams "C" value) used in friction head loss calculations must be based on the pipe material selected.

For a lift station with more than two pumps, a force main in excess of one-half mile, or firm pumping capacity of 100 gpm or greater, system curves must be provided for both the normal and peak operating conditions at “C” values for proposed and existing pipe.

A family of system head curves shall be developed to indicate the operating envelope of the pumps. These curves shall be constructed by using varying friction factors (C) to account for new condition and worn condition and wet well levels. At a minimum, curves will be established for both the “pump off” level and the “pump on” level using “C” values of 100 to 130 for ductile iron force main pipe and “C” values of 120 to 140 for PVC for force main pipe.

Once the system curve is developed, various pumps shall be analyzed to determine pump curves, including VFDs, that best fit the system curve. Multiple pumps may be required to produce the necessary flow at the required head. Duty points shall be selected to target the pumps' Best Efficiency Point (BEP)and an operating range within the pumps' Preferred Operating Range (POR). At no point shall the pumps' operating range extend outside of the Acceptable Operating Range (AOR).

Upon selecting the pump, the motor rating (horsepower) and impeller size shall be established. The Engineer shall prepare reduced speed curves as necessary for use of VFDs.

The most efficient pumps shall be selected for the given head-capacity situation as approved by the City. The selected pumps have a Net Positive Suction Head Required (NPSHR) that is less than the system's Net Positive Suction Head Available (NPSHA) under the worst-case scenario.

The proposed elevation of all critical components shall be shown in the plan sheets including, but not limited to pump intake line inverts, control, and alarm levels, Lead Pump On, Lag Pump On, Pump Off, top of the wet well, top of the dry well, influent line(s) invert(s).

All electrical equipment / panels and controls for the lift station pumps shall be mounted above ground.

11.5 Lift Station Piping, Valves and Accessories

Each pump shall have one isolation resilient-seated, full-port, eccentric plug valve downstream of the pump and check valve inside a separate watertight valve vault. This vault shall be covered and protected from the weather and have an aluminum three-foot by three-foot (minimum) spring open access hatch.

Check valves shall be located upstream of the isolation valve. A check valve must be a swing-type valve with an external weight and lever that is installed such that the swing arm is free from obstruction across the entire movement range of the arm. A ball check valve will not be accepted.

Air release valves of a type suitable for wastewater service shall be installed along the common header at the high point in the line where the force main would be prone to trapped air. An air release valve at the lift station may also need to have odor control system, as necessary.

When required, air relief valve size shall be selected based on Firm Pumping Capacity flow. It shall be rated for raw sewage service, and it shall have an isolation valve on the inlet side. The opening setting shall not exceed 5 psi above normal operating pressure of the system at header when firm pumping capacity flow is being discharged. Air relief pipe shall be routed back to either the wet well or the manhole upstream to the wet well. The engineering report must include analysis and reference information showing how the valve was selected.

Emergency bypass piping flanged connection shall be included on the discharge header, downstream of the valve vault. Bypass piping shall be extended above ground by 1.5 feet, include an isolation plug valve, and have a 3-inch quick connect coupling with cap on the end of the bypass connection. All above ground piping and fittings for bypass connection shall be ductile iron, with a minimum 400 mil of epoxy coating. All bypass piping and fittings shall be arranged in a way that allows for access on all sides of the piping and fittings for installation, maintenance, and operation.

During an emergency situation in the case of power failure and pump failure, temporary portable pumps would be able to take suction from the wet well and discharge pumped flow into the bypass quick connection coupling to the discharge header. The bypass shutoff valve and the lid at ground level must be painted green.

For large lift stations (in excess of 50 HP), the City may require piping provisions for a pig launch station / pigging cleaning operation, which will allow for future maintenance of the force main through insertion of a swab directly into the force main which is moved through the force main from operation of the pumps.

Lift stations are required to have backup power, per Section 11.7.1.

11.6 Supervisory Control and Data Acquisition (SCADA)

All lift stations must incorporate SCADA (see the City of Grand Prairie Standard Details). The Engineer shall contact the City's SCADA Contractor to coordinate the proposed lift station SCADA design. All SCADA design shall conform to the City's Standard Details.

Any alternative SCADA wireless (i.e., radio communication) technology must be addressed in the PDR and accepted by the City Director of Engineering Services, or designee.

Lightning surge arresters must be provided on main power supply, SCADA, and all other electronic equipment. Lightning protection shall be provided for antenna mast, security light pole, emergency generator and roof covering (if provided over electrical and other facilities).

Antenna must be provided for the SCADA equipment, and a Path Study must be provided by the SCADA Contractor for all antenna designs to verify the correct height of the antenna.

11.7 Emergency Provisions and Safety Considerations

11.7.1 Backup Power:

A full capacity, on-site, independently powered, backup generator with an automatic transfer switch shall be installed in all lift stations capable of providing power to pump its Firm Pumping Capacity.

Smaller lift stations (less than 100 gpm firm pumping capacity) must be equipped with a tested quick-connect mechanism, or a transfer switch properly sized to connect to a portable generator if accepted by the City Director of Engineering Services, or designee and if not equipped with an on-site generator.

11.7.2 Alarms:

Lift stations must include an audiovisual alarm system, and the system must transmit all alarm conditions to the Supervisory Control and Data Acquisition (SCADA) system.

An alarm system must self-activate for a power outage, pump failure, or a high wet well water level.

All wet well level control systems must be accepted by the City Director of Engineering Services, or designee, if using other than a Radar. All wet wells shall have a backup float switch for high water alarm.

11.7.3 Safety:

All dry pits must be sized and configured to allow for access on all sides of the pumps.

All hatches over openings into wet wells, dry pits, or other enclosures shall be constructed of aluminum.

Fall protection must be installed under all hatch openings associated with the lift station. Fall protection must be epoxy-coated steel grate installed under the hatch openings.

11.7.4 Other:

The retention capacity in a lift station's wet well and incoming gravity pipes must prevent discharges of untreated wastewater at the lift station or any point upstream for a period of time equal to the longest electrical outage recorded during the past 24 months, but not less than one hour or as directed by the City.

The City may allow / require a spill containment structure to provide means for preventing an upstream SSO based upon available storage in the system and adequate response time by City during an emergency situation.

11.8 Private Lift Station Design

Private lift stations may be considered to serve a single property where public gravity wastewater is not available or cannot be used because of elevation grade.

The City does not maintain private lift stations. Any maintenance of these assets is the sole responsibility of the property owner.

Two or more lots shall not be served through a single private lift station.

A private manhole is also required at the downstream end of the force main, prior to the gravity flow into the City collection system.

A wastewater backflow prevention device or check valve assembly shall be provided for all private lift station.

A License Agreement with the City shall be required for any private force mains that will be located within the City right-of-way or public easements dedicated to the City.

12.0 Fees

For water impact fees, tap fees, and meter fees, refer to the City's Article 22, latest edition.