# CITY OF LINDSBORG
# STANDARD ENGINEERING DESIGN CRITERIA

1995

## TABLE OF CONTENTS

# SECTION 1 – GENERAL

## PURPOSE

To protect the general health, welfare and economic well being of the users of a developed land area, it is essential to provide adequate public improvements.

This manual is intended to set forth policies for standard engineering design criteria and shall be followed where applicable.

## SCOPE

This manual consists of five major sections. Each of the major sections is subdivided into appropriate subheadings for easy reference in the Table of Contents. Sections 2 through 5 cover minimum engineering design criteria for streets, storm sewers, sanitary sewer, and water lines.

Intentionally absent from this manual are criteria for the installation of electrical services. It is felt that each new area will need to be evaluated separately, with design criteria established to meet the particular needs of that area.

## VARIATIONS FROM THE DESIGN CRITERIA

It should be stressed that it is not the intention of the City of Lindsborg to create arbitrary, rigid and inflexible rules from which no deviation shall be permitted.

Variation from the Standard Engineering Design Criteria may be granted by the City Council. Requests for variations from the Standards should be addressed to the City Council during the early project design phase.

## COMPLIANCE WITH APPLICABLE STATUTORY REQUIREMENTS

These design criteria shall not be used as a substitute for any statutory requirements relative to study, design and/or construction of any public improvement, but shall be used in conjunction with those documents to provide the finest possible project design.

Construction plans and specifications shall be sealed by a professional engineer licensed in the State of Kansas.

## AMENDMENT TO STANDARD ENGINEERING DESIGN CRITERIA

This manual will be amended as appropriate to reflect new technology.

## COMPREHENSIVE COMMUNITY PLAN

Where applicable, the “Comprehensive Community Plan” for the City of Lindsborg shall be an integral part of the planning, design and construction of public improvements within the jurisdictional territory of the City of Lindsborg.

# SECTION 2 – STREETS & TRAFFICWAYS

## GENERAL

The purpose of Section 2 is to provide minimum design criteria for the construction of streets within the city limits of Lindsborg.

Proposed minimum criteria for geometric design, thickness and characteristics are given to provide the City of Lindsborg a standard and functional transportation system with relatively low maintenance costs.

The improvement or development of streets within the City of Lindsborg should be based on a functional street classification which is part of the "General Development Plan" for the City of Lindsborg, 1995 or as revised.

## GEOMETRIC DESIGN CRITERIA

Streets & Trafficways

Street classification for the City of Lindsborg is shown in the "Comprehensive Community Plan" for Lindsborg, Kansas. This plan includes three general classes of streets: arterials, collectors and locals. Streets not shown or classified in the "Comprehensive Community Plan" shall be classified as approved by the City Council prior to design or construction.

The geometric design for respective street classifications is shown in Table II-2.

Sidewalks & Alleys

The width and location of alleys shall be as described in the City of Lindsborg's "Code of Ordinances".

All sidewalks shall be a minimum 5' in width and a minimum of 4" in depth. Where a sidewalk crosses a driveway, there shall be a minimum depth of 6". All sidewalks at street intersections shall be provided with a ramp to facilitate handicap accessibility. Ramps shall conform in length, width, slope and design to specifications as provided by the latest interpretation of the Americans with Disabilities Act.

Traffic Control Devices

The maintenance and installation of traffic control devices will be the responsibility of the City of Lindsborg. Traffic control devices shall be utilized as described in the "Manual of Uniform Traffic Control Devices" or as directed by the Lindsborg City Council.

Drainage & Erosion Control

Drainage is important on pavement as well as side and underdrainage. Section 3 – STORM DRAINAGE & FLOOD CONTROL CRITERIA describes the drainage criteria for the City of Lindsborg.

Design of streets shall include consideration for growth of shrubs within the right-of-way. If sufficient right-of-way exists, consideration may be given to planting trees within the right-of-way. Seeding, mulching and sodding of slopes, swales and other erodable areas shall be a part of the design plans.

## PAVEMENT THICKNESS AND PAVEMENT TYPE

Design Factors

The following factors should be considered in determining the pavement thickness:

1. Variable subgrade conditions & soil characteristics.

2. Expected variations in traffic intensity & wheel load.

3. Maintenance costs.

Traffic Considerations

The three general traffic classifications for purposes of practical application in design of specific projects are as follows:

1. Light Traffic. Predominately passenger car traffic on local residential streets, light to medium intensity, 4000 pound design wheel loading, minor truck traffic.

2. Medium Traffic. Mixed traffic of medium intensity on collector streets, 6000 pound design wheel loading, moderate truck traffic.

3. Heavy Traffic. Mixed traffic of high intensity on arterial, collector or industrial

The above traffic classifications are intended to cover the various traffic conditions normally encountered in the City of Lindsborg. These classifications do not include considerations for Interstate or Major Expressway design standards since such projects will require special considerations.

Rigid & Flexible Pavement Thickness

Construction or rigid or flexible type pavement shall meet the minimum requirements indicated in Table II-1.

### TABLE II-1

| Traffic Classification | Rigid Pavement 5,000 psi Concrete with 42 lb./S.F. Reinf. Mesh | Flexible Pavement Hot Mix Asphalt, Full Depth |
|---|---|---|
| Light Traffic | 6” Thickness | 7” or Equivalent |
| Medium Traffic | 7” Thickness | 8” or Equivalent |
| Heavy Traffic | 8” Thickness | 9” or Equivalent |

Table II-1 does not infer that the two basic types of pavement are equal to each other with respect to load carrying characteristics, permanence and maintenance costs. The Lindsborg City Council has determined that all new streets shall be concrete pavement. Pavement type to rehabilitated or reconstructed streets will be determined on an individual basis, according to the characteristics of each street.

The thicknesses shown in Table II-2 are recommended minimums. Minimum pavement thicknesses are based upon the assumption that the subgrade will be uniform in bearing characteristics. Scarifying, mixing and Type B compaction of the top 6", as detailed in the Kansas Department of Transportation, "Standard Specifications for State Road and Bridge Construction" are minimum requirements.

## TABLE II-2

### GEOMETRIC STREET DESIGN STANDARDS

| | ARTERIAL | COLLECTOR | | | | LOCAL | | |
|---|---|---|---|---|---|---|---|---|
| | Major W/median | Major | Rural | Resid. | Indust. | Resid. | Indust. | Cul de sacs |
| Design Speed | 40 | 40 | 40 | 30 | 30 | 30 | 30 | 30 |
| Min. R/W width | 120 – 150' | 100' | 120' | 80' | 80' | 60' | 70' | 60' rad. |
| Min pav't width Back to back Of curb | 2 @ 28' | 60' | 44' | 41' | 45' | 31' | 44' | 35' rad. |
| Min. median Width | 14' | - | - | - | - | - | - | - |
| Max. grade | 5.5% | 5.5% | 5.5% | 6.5% | 6.5% | 8.5% | 8.5% | - |
| Min. Grade | 0.5% | 0.5% | 0.5% | 0.5% | 0.5% | 0.5% | 0.5% | - |
| Min. stopping Sight distance | 275' | 275' | 275' | 200' | 200' | 200' | 200' | - |
| Min. radii of Horiz. Curves | 400' | 400' | 400' | 300' | 300' | 200' | 200' | - |
| Min intersection Curb radius | 50' | 50' | 50' | 40' | 40' | 30' | 30' | - |
| Min pavement Cross slope | 3/16"/ FT. | 3/16" | 3/16" | 3/16" | 3/16" | 3/16" | 3/16" | 3/16" |

# SECTION 3 – STORM DRAINAGE & FLOOD CONTROL CRITERIA

## GENERAL

To protect the general health, welfare and economic well being of the user of a developed land area, it is essential to provide adequate storm drainage facilities.

The purpose of Section 3 is to develop general methods of planning and designing storm sewer systems.

The design criteria are not expected to cover all conceivable situations to be encountered in engineering design. These criteria shall allow for minor deviations depending upon individual design situations.

## Planning

The Planning & Zoning Commission shall not recommend for approval any preliminary plat of a subdivision which does not make adequate provisions for storm water runoff control. This control may be accomplished through the use of detention basins, open channels and/or closed conduits. The applicant/developer shall determine the effects of the proposed subdivision on all upstream and downstream drainage conditions. The drainage investigation shall assume the ultimate development of the entire drainage basin based upon the current land use plan and the current and proposed zoning of the land within the drainage basin. Calculation of storm flows and runoff characteristics of the subdivision shall be performed in accordance with the design criteria established in Section 3 of this manual. The City of Lindsborg reserves the right to require the developer of the proposed subdivision to construct or cause to be constructed all necessary storm drainage systems, designed in accordance with the design criteria established in Section 3 of this manual, prior to the issuance of any building permit.

## METHODS OF ESTIMATING RUNOFF

### Rational Method

#### General

The Rational Method may be used to determine the amount of storm water runoff from a given area. This formula is expressed as: **Q = CIA** in which **Q** is the peak runoff rate in cubic feet per second, **C** is a runoff coefficient depending on the characteristics of the drainage area, **I** is the average rainfall intensity in inches per hour, and **A** is the drainage area in acres.

#### Runoff Coefficients.

Values of the coefficient, C, classified with respect to the general character and projected ultimate development based on the City's land use plan, subject to the interpretation and judgment of the engineer are shown in Table 3 – 1

## TABLE III – 1

| Description of area | Runoff Coefficients |
|---|---|
| Business | |
| Downtown or Shopping Center | 0.70 – 0.95 |
| Neighborhood | .50 - .70 |
| Residential | |
| Single Family | .30 - .60 |
| Multi-Units (detached) | .40 - .70 |
| Multi-Units (attached) | .60 - .80 |
| Suburban Residential | .25 - .40 |
| Apartment | .50 - .70 |
| Industrial | |
| Light | .50 - .80 |
| Heavy | .60 - .90 |
| Parks, Cemeteries | .10 - .25 |
| Railroad Yard | .20 - .35 |
| Unimproved | .10 - .30 |

Where it is desirable to develop a composite runoff coefficient based on the percentage of different types of surface, the following shall be used as a guide:

| Character of Surface | Runoff Coefficients |
|---|---|
| Pavement | |
| Asphalt & Concrete | 0.80 – 0.95 |
| Brick | .80 - .85 |
| Roofs | .75 - .95 |
| Lawns, sandy soil | |
| Flat, 2% | .05 - .10 |
| Average, 2% - 7% | .10 - .15 |
| Steep, 7% + | .15 - .20 |
| Lawns, Heavy Soil | |
| Flat, 2% | .13 - .17 |
| Average, 2% - 7% | .18 - .22 |
| Steep, 7% + | .25 - .35 |

These coefficients are applicable for storms of 5 to 10 year frequency. Less frequent, higher intensity storms will require the use of higher coefficients.

Intensity (I).

The rainfall intensity in inches per hour shall be determined by using the Rainfall Duration – Intensity Curves for Lindsborg, Kansas, developed from the "Rainfall Frequency Atlas of the United States," Technical Paper 40, U. S. Weather Bureau, for the frequency and time of concentration specified in Section 3 of this manual. The duration time or time of concentration to be used shall be estimated by

the designer and shall include time for overland flow, channel flow and pipe flow to the point under consideration. Appropriate nomographs or equations may be used in estimating the time of concentration. The minimum time of concentration shall be 15 minutes.

Drainage Area (A).

The drainage area for the point under consideration must be established. It can be determined by field survey, aerial photographs or suitable maps, as appropriate. For design purposes, it must be assumed that the area is fully developed as shown on the City use plan.

Other Methods

Semi-empirical methods may be used for calculating runoff quantities and peak rates for areas greater than 100 acres.

The semi-empirical method of the Soil Conservation Service shall be an accepted method for the City of Lindsborg. A detailed discussion of the SCS Method is presented in Urban Hydrology for Small Watersheds, Technical Release Number 55, January 1975, Soil Conservation Service; or National Engineering handbook, Section 4, Soil Conservation service.

## DESIGN FLOW RATES

General

The minimum design capacity of drainage facilities shall provide for the anticipated quantity of storm water calculated for Lindsborg, Kansas, by using the methods described above or other appropriate methodology. The anticipated quantity shall be based on the return periods listed below.

General Hydraulic calculations for a 100-year storm shall be made to protect against extensive and prolonged flooding of permanent structures.

Design Rainfall Return Period

The following minimum rainfall return rates shall be used:

### TABLE III – 2

| | Use | Design Return Period |
|---|---|---|
| 1. | Residential Area, Local Streets. Collector Streets | 5 Yr. – 10 Yr. |
| 2. | Commercial Property, Public Buildings, Industrial Areas, Arterial Streets, Major Open Channels | 10 Yr. – 25 Yr. |
| 3. | Critical Areas, Flood Plains in Commercial Areas, Flood Plains in Residential Areas, As directed by City of Lindsborg | 50 Yr. – 100 Yr. |
| 4. | Detention Storage Facilities | |
| | Principal Spillway | 50 Yr. |
| | Emergency Spillway | 100 Yr. |
| | Freeboard | 100 Yr. + 1’ |

Major Storms

Provisions should be made to handle runoff from a major storm (up to 100 year frequency) without threat to personal safety or undue property damage. Methods by which protection can be provided include provisions for temporary storage or overland flow of excess runoff, drainage easements sufficient to cover anticipated flows and adequate hydraulic design for bridges and other structures.

Floodway and floodway fringes are shown in the "Flood Insurance Rate Map", Community-Panel No. 200214 0050 B, and the "Flood Boundary and Floodway Map", Community-Panel 200215 0001 B, USD HUD, for Lindsborg, Kansas.

## INLETS

Gutter flows in arterial streets shall be limited to 10 feet of lane width for the design storm. The same criteria are to be applied to streets in commercial areas or other areas of high public use such as the business districts, schools, etc. In most collector and local streets, flows shall be a maximum of curb depth for the design storm except where these streets approach an arterial street or other areas described above. Sump areas normally will be the controlling locations.

Inlet interception capacity will be based on appropriate hydraulic formulas, charts and nomographs.

Inlets preferably shall not be located within the curb return area at intersections unless it is a sump condition and not practical to locate elsewhere. Inlets shall not be located at crosswalk locations.

## STORM SEWER PIPE

Sizing

Pipes shall be sized for the amount of water calculated to be in the pipe for the theoretical design conditions.

All velocity and flow calculations shall be based on the Manning Formula using the appropriate "n" values given below:

### TABLE III – 3

| Pipe Material | Mannings "n" |
|---|---|
| Concrete Pipe | 0.013 |
| Asbestos Cement | 0.012 |
| Vitrified Clay | 0.013 |
| Concrete Box | 0.015 |
| Corrugated Metal | 0.025 |

Velocity

The minimum allowable velocity shall be 2 fps. Velocities at outlets shall be held to a minimum to prevent erosion. Energy dissipating riprap shall be provided where necessary.

Minimum Pipe Size

The minimum diameter of storm sewer pipe shall be 12".

Minimum Depth

When practical, a minimum of two feet of earth cover will be provided in grassed areas. Depths of cover under streets, parking lots, etc., shall be determined by strength calculations.

Storm Sewer Strength & Materials

The structural design for storm sewers and appurtenances should follow the general structural design concept of appropriate Kansas Department of Transportation Standards, manufacturers' recommendations, and generally accepted sound engineering and design practices.

Storm sewer construction materials shall comply with appropriate ASTM Standards.

## OPEN CHANNELS

General

Careful planning is necessary to utilize the advantages of open channels in conveying storm water runoff. Special planning and design efforts shall be made to preserve the existing condition and alignment of the natural channel. Artificial channels shall follow natural channel alignment as closely as possible. Special attention shall be given to safety considerations and appropriate grading and fencing shall be provided wherever it is necessary to reduce the potential for injury to the public. Sufficient right-of-way and/or permanent easements, necessary to provide effective operation and maintenance, shall be provided.

Velocity

Open channel design and construction shall provide for appropriate protection against erosion caused by high velocities. Maximum flow velocities at the design flow rate shall not exceed the following values without provisions for erosion protection.

| Type of Lining | Maximum Velocity |
|---|---|
| Grass lined | 5 fps |
| Riprap | 15 fps |
| Concrete | As Required |

Design of Open Channels

The design of open channels shall be based on the Manning equation, using the following "n" values:

## TABLE III – 4

| Channel Material | Mannings n* |
|---|---|
| Artificial Channels: | |
| Concrete Lined | 0.015 |
| Riprap | 0.04 |
| Grass Lined | 0.03 |
| Natural Channels | |
| Clean Straight | 0.03 |
| Irregular side slopes and bottom, Some weeds | 0.045 |
| Sluggish, weedy, deep holes Some timber | 0.07 |
| Very weedy, deep holes, water Trees and bushes | 0.1 |

*Use appropriate reference material for channel descriptions and "n" values not shown.

Freeboard

A minimum of 1 foot above the design water surface elevation shall be provided.

Side Slopes

Side slopes for man made channels shall not be steeper than three horizontal to one vertical (3:1) for grass lined channels and two horizontal to one vertical (2:1) for other lined channels.

Culvert Design and Sizing

Culverts shall be designed in accordance with the criteria of the Kansas Department of Transportation. KDOT culvert standards are acceptable if they meet appropriate structural requirements.

## DETENTION STORAGE

General

Storm water storage facilities may be used in the development of upstream areas to reduce the peak runoff rates which may have an adverse impact on existing downstream facilities. The detention storage facility shall reduce the downstream peak flows to a value equal to or less than existing flows.

Design Criteria

The design storm shall be a storm of 24 hour duration with the appropriate return period as required in Section 3 – Design Rainfall Return Period.

Outlet works shall be designed to limit peak outflow rates from detention storage areas to or below peak flow rates that would have occurred prior to the proposed or zoned developments of the tributary area. The outlet works shall not

contain any mechanical components or devices and shall function without requiring attendance or control during operation.

Emergency spillways shall be provided to permit safe passage of water from storms that exceed the principal spillway outlet capacity.

Regulations

Appropriate criteria and regulations of the Kansas Department of Agriculture, Division of Water Resources shall be recognized and adopted in the design of the storage facility.

Land Requirements

Permanent easements for the temporary impoundment of storm water runoff shall be dedicated to the City for all land, structures and facilities to be used for the temporary detention and conveyance of storm drainage. Easements shall include all necessary provisions and land necessary for the City's access for purposes of inspection and/or maintenance. All instruments and easements shall be subject to the approval of the City.

Maintenance

Provisions acceptable to the City for perpetual maintenance of temporary detention facilities, outlet works, and appurtenances, shall be made.

# SECTION 4 – SANITARY SEWERS

## TYPES OF SEWERS

Separate sewers are required for the collection of wastewater and stormwater. Roof, areaway, garage or foundation drains shall not be connected to sanitary sewers.

## DESIGN BASIS

Wastewater collection systems shall be designed for the estimated ultimate population of the area being served.

### Per Capita Flow

New sewer systems shall be designed on the basis of average daily per capita flow of sewage of not less than 100 gallons per day, a figure that assumes normal infiltration. For existing systems, an additional per capita allowance shall be made where the average annual flow exceeds this value.

### Design Flows

The design flow for sanitary sewers should be selected after consideration is given to the nature of the contributing area. Residential area maximum flow rates shall be computed by multiplying the average daily per capita peak flow by a factor of five. Commercial and industrial flow rates will be considered on a case-by-case basis.

### Design Flow Depth

Sewers up to and including a diameter of 18 inches should carry the design flow when running two-thirds full. Sewers larger than 18 inches in diameter should carry the design flow when running three-fourths full.

### Capacity

In areas which are substantially developed, the design capacity is to be based on existing measured flows, an allowance for infiltration/inflow, and capacity for reasonable future development.

## DETAILS OF DESIGN, CONSTRUCTION AND MATERIALS

### Minimum Size

No public gravity sewer shall be less than 8 inches in diameter.

### Depth

In general, sewers should be sufficiently deep to receive sewage from basements and to prevent freezing. A minimum earth cover of 30 inches shall be provided for all sewers.

### Slope

The vertical gradient shall be such that a velocity of at least 2.0 feet per second for pipes running one-half full will be maintained, based on Manning's formula using n = 0.013. The following table lists minimum slopes to be provided:

# TABLE IV – 1

**SLOPES REQUIRED FOR V=2fps**
**FULL AND HALF FULL FLOW**

| Pipe Diameter (inches) | Manning n=0.013 | Pipe Slope (%) |
|---|---|---|
| 8 | | 0.40 |
| 10 | | 0.28 |
| 12 | | 0.22 |
| 15 | | 0.15 |
| 18 | | 0.12 |

For eight inch pipes only, the following requirements apply:

The minimum acceptable grade for the pipe will be 0.40%, regardless of material of construction, except as noted below.

Grades slightly less than 0.40% for any type of pipe will only be accepted when a lift station may be eliminated, where the cost of constructing the sewer line at 0.40% grades will be extremely prohibitive as compared to the cost of constructing the line at the lesser slope plus the cost of the additional maintenance the line will require, or where other technical considerations warrant. The use of grades below 0.40% will not be routinely authorized.

Where grades below 0.40% are authorized, the Kansas Department of Health and Environment will require notification that the potential exist for additional maintenance, and that the owner is prepared to take necessary action to prevent deposition of solids for the life of the system.

When two sewers of the same size and same slope are joined by a manhole, a continuous grade through the manhole should be provided.

Increasing Size

When a sewer joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain a continuous energy gradient. Approximate methods for securing this result are to place the 0.8 depth point of both sewers at the same elevation or to place the crowns of the sewers at the same elevation.

High Velocity Protection

Where velocities greater than 10 fps in the sewer are possible, special provision shall be made to protect against erosion. This protection may be secured utilizing ductile iron pipe.

Where pipe slopes exceed 15% and manhole spacing exceed 100 feet, special provisions must be made to anchor the sewer securely at least for every 100 feet of sewer. The use of concrete collars and/or concrete encasement is recommended for this purpose.

Sewer Joints

Sewer joints shall be designed to minimize infiltration-exfiltration and to prevent the entrance of roots. Premixed cold joint material or cement mortar joints shall not be used. This prohibition does not prevent use of factory applied joints of demonstrated quality.

Materials for Sewers

Any generally accepted material for sewers will be given consideration. The material selected should be adapted to local conditions, such as characteristics of wastes, possibility of septicity, soil characteristics, exceptionally heavy external loads, abrasion and similar problems.

Types of pipe approved by the Kansas Department of Health and Environment include Ductile Iron Sewer Pipe (DIP), ABS Composite Sewer Pipe, Poly Vinyl Chloride Sewer Pipe (PVC), and Vitrified Clay Pipe (VCP). It would be preferred that the Vitrified Clay Pipe NOT be used except in cases where it can clearly be demonstrated that it's use would be considered superior in a given specific application.

In accordance with requirements of the Kansas Department of Health and Environment, ductile iron pipe or concrete encasement shall extend not less than 10 feet each way wherever sanitary sewer lines cross over domestic water lines or within a clear vertical distance of two feet below said water lines; PVC pipe may be substituted for ductile iron pipe provided any joints in the PCV pipe within 10 feet each way from the intersecting water line are solvent welded. A minimum horizontal distance of 10 feet shall be maintained between the new sewer lines and existing parallel water lines.

Trenching

Wherever possible, trench widths shall not be more than 24 inches greater than the pipe diameter for pipes 30 inches in diameter or less. Wider trench widths may be used for larger than 30 inch pipes and/or trenches greater than 14 feet deep.

Bedding

The bottom of the trench shall be overexcavated and the pipe shall be bedded with compacted granular material placed on a flat trench bottom and extending from 4 inches below to the springline of the pipe for PVC and ABS pipe, and to the flowline for VCP or DIP pipe. The pipe bedding shall be compacted in place. The bedding shall then be extended to 6 inches above the pipe for PVC or ABS pipe.

Bedding classes A, B, or C, as described in ASTM C 12, shall be used for all rigid sewer pipes (VCP and DIP). Bedding classed I, II or III as described in ASTM D 2321, shall be used for semi-rigid (ABC Composite) and flexible sewer pipe (PVC).

Laying Pipe

Pipe laying shall precede upgrade, with spigots pointing in direction of flow. Pipelines shall be installed with due care for alignment and grade.

Sewer Service Connection

Sewer service connections shall be no less than 4 inches in diameter and shall be installed at a minimum slope of ¼ inch per foot. Vertical risers will not be approved. The following is the approved method of installing sewer service connections:

The branch connection of the wye shall be set at an angle of 45degrees to the horizontal and a 45 degree bend shall be places on the branch. If required, a riser pipe shall then connect to the service sewer with another 45 degree bend. Connections shall be Schedule 40.

Aerial Crossings

Support shall be provided at all joints in pipes utilized for aerial crossings. Ductile iron pipe shall be used for aerial crossings.

Highway and Railroad Crossings

Adequate protection shall be provided to prevent failure of the sewer line or force main at highway and railroad crossings. The design engineer must demonstrate the adequacy of the protection provided and have the approval of the owner of the specific crossing location.

## ACCEPTANCE TESTS FOR SEWERS

Alignment

Sewers shall be laid with straight alignment between manholes. Alignment tests such as “lamping” or TV inspection must be conducted. The use of a laser in construction and testing is recommended.

Infiltration-Exfiltration

Hydrostatic or air pressure tests shall be conducted on sewers before acceptance by the City. Infiltration-exfiltration shall not exceed 250 gallons per day per inch of nominal pipe diameter per mile of sewer line for any section of the system.

## MANHOLES

Manholes shall be constructed of materials resistant to or protected from bacteria degradation, acid and alkaline solutions, normal sewer temperature variation, abrasion, industrial wastes or other materials which may be transported by the sewer.

Location

Manholes shall be provided at the end of each line; at every change in grade or alignment; at all intersections; where pipe sizes change; and at distances not greater than 400 feet.

Access

The primary purpose in constructing manholes is to provide access to the sanitary sewer for inspection, routine preventative maintenance and for emergency service. Manholes shall be constructed at locations that will provide convenient access of men and equipment to the manhole.

The preferable location for sanitary sewers is in a dedicated street or alley right-of-way. Where this is impossible or impractical, sewers may be located in permanent easements. Permanent maintenance easements should be adequate in width to allow access and egress of maintenance personnel, vehicles and equipment. Above ground obstructions that are located in the easements such as utility poles, transformers, telephone junction boxes, meters, etc., should be located off center of the easement to avoid interfering with access to and egress from any location over the

sewer line. Obstructions belonging to adjacent property owners such as fences, retaining walls, tree shrubs, utility buildings, etc., should not be permitted on permanent utility easements. The minimum recommended width for permanent maintenance easements for sewers is sixteen feet, with twenty feet being desirable. In subdivisions where sewers are installed in easements, the easement should not terminate a short distance past the last lot line in the block, but should instead extend to the street right-of-way for access.

Where sewers are installed in easements, the sewer should be designed so that at least one of the manholes in each stretch of sewer is readily accessible in a dedicated street or alley right-of-way. It is highly desirable to have the downstream manhole available whenever possible for cleaning with a high pressure hydraulic sewer cleaner.

Drop Pipe

An outside drop pipe shall be provided for a sewer entering a manhole at an elevation of 24 inches or more above the manhole invert. The outside drop pipe shall be protected against breaking or settling by the use of concrete encasement. For pipe diameters of 8 inches to 12 inches, the drop pipe shall have the same nominal diameter as that of the incoming sewer. For larger pipe sizes, a minimum 12 inch diameter drop pipe shall be provided.

Diameter

The minimum inside diameter of manholes shall be 48 inches. The minimum diameter of manhole entry ways shall be 22 inches.

Steps, Rings & Lids

Manhole steps, rings and lids shall be made of gray cast iron conforming to ASTM A 48. Steps shall be provided whenever the manhole is deeper than 4 feet. Steps shall be placed at intervals no greater than 16 inches.

Manhole rings and lids shall have a minimum weight of 275 lbs and shall have machined contact surfaces. Solid manhole lids shall be utilized.

Manhole rings shall be constructed on manholes so that no infiltration or inflow may enter the manhole.

Manhole Construction

Manholes may be constructed of precast concrete or cast-in-place concrete, and shall be of materials and to dimensions approved by the Kansas Department of Health and Environment.

The flow channel through manholes shall be made to conform in shape and in slope to that of the sewer. Sewer pipe, with the top half removed, should be laid through the manhole whenever possible.

The inside bottom of the manhole shall rise a minimum of 1 inch per foot from the inside of the pipe or the flow channel to the wall of the manhole. Dips or projections capable of holding water or solid materials will not be permitted.

## CLEANOUTS AND LAMPHOLES

Lampholes shall not be used but cleanouts may be used to terminate lines. Cleanouts shall be designed in such a manner as to make any extension of the sewer line impossible without removing the cleanout. The diameter of the cleanout shall be the same as that of the sewer.

## SEWAGE PUMPING STATIONS

In general, sewage pumping stations should be sited where they are protected from physical damage by a 100 year flood and remain fully accessible and operational during a 25 year flood. A suitable superstructure located off the right-of-way of streets and alleys should be provided. Sewage pumping stations shall be capable of pumping the maximum received flow, and shall be designed to meet all current criteria of the Kansas Department of Health and Environment.

## PROTECTION OF WATER SUPPLIES

There shall be no physical connection between a public or private potable water supply system and a sewer, or appurtenance thereto, which would permit the passage of any wastewater or polluted water into the potable water supply.

Sewer lines, i.e., house connection, laterals, trunk lines, interceptors, force mains, etc., shall not be constructed within a 100 foot radius of a public water supply well. Greater separation may be required where soil and drainage conditions indicate the need for greater protection.

Sewer lines constructed of cast iron or solvent welded plastic pipe materials may be constructed within 10 feet of a private water supply well. Sewer lines constructed of non-watertight materials must be at least 50 feet from a private water supply well.

Water and sewer lines shall not be placed in the same trench or excavation.

# SECTION V – WATER SYSTEM CRITERIA

## GENERAL

All water system design shall comply with the State of Kansas Department of Health and Environment minimum design requirements and the Insurance Services Office of Kansas fire protection requirements. All water system design, installation and construction shall be in accordance with AWWA Standards and or manufacturer's recommendations.

## WATER MAIN DESIGN

Pressure

The normal working pressure in the water distribution system should be approximately 55 psi at ground level and not less than 35 psi. A minimum pressure of 20 psi at ground level shall be maintained at all points in the distribution system under all conditions of flow, except under extraordinary conditions of flow such as would occur when a water main breaks.

Flow rates and fire protection

The minimum flow rate in the water distribution system shall be equal to the fire flow plus the maximum day consumption rate or peak hourly rate, whichever is greater.

Suggested fire flows are shown in Table V-1 as a general guideline. However, actual fire flows shall be determined using criteria contained in the "Guide for Determination of Required Fire Flows", published by the Insurance Services Office of Kansas (ISO). ISO criteria establish fire flow requirements based on the type of construction and the total floor area of a given building. The required fire flows are then adjusted with consideration given to the separation distance and exposure length of surrounding buildings, provision of an automatic sprinkler system, and type of occupancy (low hazard or high hazard).

### TABLE V-1

### FIRE FLOW REQUIREMENTS

| Land Use Classification | Recommended Fire Flow (gpm) |
|---|---|
| Residential (single and two-family) | 500 – 1,500 |
| Residential (multi-family) | 1,000 – 2,500 |
| Public and Semi-Public | 1,000 – 2,500 |
| Commercial | 1,000 – 2,500 |
| Industrial | 1,500 – 2,500 |

The fire flow shall not be less than 500 gpm.

Main Sizes

All water mains shall be sized to supply at least the minimum pressure and flow requirements outlined previously.

In newly developing residential areas, the minimum main size shall be 6 inches, except for a small cul-de-sac, serving 4 homes or less, a 4 inch main may be used.

In newly developing commercial and industrial land use areas, the minimum main size shall be 8 inches.

System Layout

Water distribution system mains shall be looped and interconnected with in every 600 to 800 feet whenever possible to form a complete gridiron. Dead-end mains shall be avoided, but in the event that a dead-end main is necessary, a shutoff valve shall be placed on the main to accommodate future extensions.

Valve Spacing

A sufficient number of valves shall be installed to isolate not more than 1,200 feet of arterial mains, 800 feet of distribution mains, or 500 feet of mains in commercial areas. Valves shall be located near interconnections of adjoining mains and in accordance with these spacing requirements.

Maintenance

The water system shall be operated and maintained by the City.

Easement

All water mains shall be installed within street right-of-way where possible. The minimum easement for water mains shall be 20 feet where possible, 10 feet each side of the centerline of the main. Additional allowance for temporary construction easements may be required where construction conditions warrant.

## SEPARATION OF WATER MAINS AND SANITARY SEWERS

Watermains Paralleling and Crossing Sewer Mains

When potable water mains and sanitary sewer are laid parallel to each other, the horizontal distance between them shall not be less than 10 feet.

The laying of water of water mains and sanitary sewers shall be in separate trenches with undisturbed earth between them.

When a water line and a sanitary sewer cross and the sewer is two feet or more (clear space) below the water pipe, no additional protection to the water line is needed. At all other crossings, the sewer shall either be:

a) Constructed of either ductile iron pipe or plastic pipe with solvent welded joints, for 10 feet both directions from the crossing;
b) Encased in concrete with a minimum of 6 inch thickness above and below the pipe, for 10 feet either side of the crossing.

Cross Connections

There shall be no cross connections between the potable water system and any sewer or other contaminated source.

## INSTALLATION OF WATER MAINS

Standards

Installation of water mains shall be in accordance with AWWA Standards and /or the manufacturer's recommended installation procedures.

Cover

Water mains shall be buried with at least 4 feet of soil cover. Cover is the distance from finish grade to the top of the pipe.

Depth

Unless there are extenuating circumstances, water mains shall not be laid deeper than 6 feet and only then with permission from the Public Works Department.

Blocking

All tees, bends, plugs and hydrants shall be provided with concrete thrust blocks, tie rods, or joints designed to prevent movement.

Street Crossings

Water mains crossing existing arterial and collector streets shall be augured and jacked under those streets, unless the City approves open cutting of the street. Generally, permanent streets will be bored; non-permanent streets may be open cut.

Hydrostatic Testing and Disinfection

All water mains shall be pressure tested, disinfected and flushed prior to being put into service.

## WATER SERVICES

Service Connections

All service connections are to be metered. Meters are to be set just inside the property line and not on public right-of-way, and will be set in a meter pit with a 2 piece lid designed for metering installations. Pre-manufactured meter setters are to be utilized in all installations unless prior approval from the City is given. All fittings shall be brass or bronze.

Shared service lines will not be permitted.

Service Line Size

Service lines shall be a minimum of ¾ inch.

## HYDRANTS

Location and Spacing

Fire hydrants may be located at each street intersection and intermediate points if necessary. Hydrant spacing shall not exceed 800 feet. In areas where the fire flow exceeds 2000 gpm, the spacing shall not exceed 500 feet. A hydrant shall be located on the end of dead-end mains for flushing purposes.

Hydrant Lead

Hydrant lead shall be a minimum 6 inches in diameter. A valve shall be installed on all hydrant leads.

## MATERIALS

Standards

All materials, including pipe, pipe fittings, valves and fire hydrants shall, at a minimum, conform to the latest AWWA Standards and be acceptable to the City.

Pipe

All water mains shall be PVC-C900.

Valves

Valves shall be open when turned left (counterclockwise). Valves shall be resilient-seat gate valves and manufactured by Mueller, M&H or of equal quality approved by the City.

All valves shall have valve boxes.

All valves located within a street or sidewalk shall have a cast iron riser.

Fire Hydrants

Fire hydrants shall be three-way with one 4-1/2 inch pumper nozzle and two 2-1/2 inch nozzles. Bottom main valve shall be at least 5 inches in diameter. Shoe shall be 6 inch. Hydrants shall be manufactured by Mueller, Kennedy, or Clow.