

**City of Lawrence
Design Criteria
Section 5500 – Sanitary Sewer (8” to 18” Mains)**



Revised: January 2018

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ATTACHMENTS

A Design Flow Example

- B Standard Easement Document – Permanent
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- D KDHE Application

Section 5500-Sanitary Sewers

SECTION 5501 SCOPE

This document establishes the minimum standards for plans for sanitary sewer main extensions and relocations within the jurisdiction of the City of Lawrence, Kansas. The following requirements are minimum requirements.

This document supplements the “Minimum Standards of Design for Water Pollution Control Facilities” adopted by the State of Kansas Department of Health and Environment (KDHE). In the event of a conflict between the documents, the stricter or more conservative requirement shall apply.

SECTION 5502 SUBMITTAL REQUIREMENTS

5502.1 Initial Plan Submittal: The initial plan submittal shall include all of the following documentation: one (1) set of plans, the KDHE application for sewer extension permit, one (1) copy of the downstream sewer capacity analysis, the draft final plat or parcel legal description if the property will not be platted, and one copy of the project specifications. In addition, all plan submittal documentation shall be provided on a CDROM, DVD, or equivalent media in portable document format (pdf).

The submittal will not be reviewed if any of the items listed above are incomplete or omitted from the submittal.

1. Plan Sets: One (1) set of plans shall be submitted with the initial submittal. All plan sheets in the initial submittal shall be signed, sealed and dated by a Professional Engineer (P.E.) licensed in the State of Kansas in accordance with Kansas Board of Technical Professions requirements. Plans will not be reviewed if the seal, signature, or date have been omitted. All references to the Engineer in this document shall be to the Professional Engineer (P.E.) preparing the plans.
2. KDHE Application: The Engineer must complete the application for sewer extension permit for all projects. The flow estimates are to be based upon the actual land use(s) proposed for the site. A flow estimate for each land use shall be included. Flow estimates for future plats, where the future plat will be served by future main extensions projects, are to be included in the application for the future main extension project only. A copy of the KDHE application is included as Attachment D of these criteria.
3. Downstream Sewer Analysis: The Engineer shall submit one (1) copy of the approved downstream sewer capacity analysis. Downstream sewer capacity analysis shall be performed in accordance with City of Lawrence Administrative Policy AP-76.
4. Draft Final Plat or Parcel Legal Description: The draft final plat shall be provided with the initial plan submittal. The property legal description shall be included on the layout sheet if the property will not be platted. The legal description shall be signed, sealed, and dated by a Land Surveyor (L.S.) licensed in the State of Kansas in accordance with Kansas Board of Technical Professions requirements. It is

recommended that draft written easements be submitted with the initial plan submittal.

5. Project Specifications: One (1) copy of the draft project specifications shall be provided with the initial submittal. The Engineer shall identify any special conditions that warrant deviation from the City of Lawrence Construction and Material Specifications Section 2500 – Sanitary Sewer (8” to 18” Mains), current edition.
6. Comments: The initial submittal and all subsequent submittals shall be reviewed by the City of Lawrence. The City of Lawrence shall provide written comments as well as plan “mark-ups” to the Engineer. The Engineer is encouraged to schedule a meeting with staff to review comments following the initial submittal. The Engineer must address all comments by revisions to the intermediate submittals or by written response as applicable. Plans will not be released for construction until all comments have been addressed by the Engineer.

5502.2 Intermediate Submittals: Intermediate submittals shall include all of the following documentation: one (1) set of plans, one (1) copy of the draft final plat or parcel legal description if the property will not be platted, one (1) draft copy of any written easements (if required), one (1) copy of the project specifications (if required), one (1) copy of a written response to comments, and original “mark-ups” as provided to the Engineer with the review of the previous submittal. In addition, all plan submittal documentation shall be provided on a CD-ROM, DVD, or equivalent media in portable document format (pdf).

The submittal will not be reviewed if any of the items listed above are incomplete or omitted from the submittal.

1. Plan Sets: One (1) set of plans shall be submitted with intermediate plan submittals. All plan sheets in the intermediate submittal shall be signed, sealed and dated by a Professional Engineer (P.E.) licensed in the State of Kansas in accordance with Kansas Board of Technical Professions requirements. Plans will not be reviewed if the seal, signature, or date have been omitted. All references to the Engineer in this document shall be to the Professional Engineer (P.E.) preparing the plans.
2. Draft Final Plat or Parcel Legal Description: One (1) copy of the draft final plat shall be provided with intermediate plan submittals. The draft final plat shall fully address all comments from the previous submittal. The property legal description shall be included on the layout sheet if the property will not be platted. The legal description shall be signed, sealed, and dated by a Land Surveyor (L.S.) licensed in the State of Kansas in accordance with Kansas Board of Technical Professions requirements.
3. Written Easements: One (1) draft copy of all easements required for the project shall be submitted with intermediate submittals. The written easements shall be signed, sealed, and dated by a Land Surveyor (L.S.) licensed in the State of Kansas in accordance with Kansas Board of Technical Professions requirements.

4. Project Specifications: One (1) copy of the project specifications shall be provided with the intermediate submittals. The Engineer shall fully address all comments from the previous submittal.
5. Written Response to Comments and “Mark-Ups”: The engineer shall prepare a written response to all comments received from the previous submittal. The Engineer shall return “mark-ups” received from the previous submittal with corrective actions taken noted on the “mark-up”.

5502.3 Final Submittal Requirements: Final plan submittal shall include three (3) sets of complete plans, one (1) copy of the downstream sewer analysis, and one (1) copy of the recorded final plat and/or executed written easement(s), one (1) copy of the project specifications (if required), and one (1) CD-ROM, DVD, or equivalent media containing all final plan submittal documentation in portable document format (pdf).

1. Plan sets shall be distributed as follows:
 - a. City of Lawrence 2 copies (1 set file copy, 1 set inspections department)
 - b. KDHE 1 copy

5502.4 Additional Cover Sheets: When requested by the City, the Design Engineer shall provide a minimum of one (1) additional cover sheet of the plan set for inclusion with the KDHE permit application. The cover sheets shall be signed, sealed and dated by a Professional Engineer (P.E.) licensed in the State of Kansas in accordance with Kansas Board of Technical Professions requirements.

5502.5 Review Period: Review time for the initial and subsequent submittals shall be ten (10) business days.

SECTION 5503 PLAN CONTENT AND ORGANIZATION

5503.1 Cover Sheet: This section establishes the minimum standards relating to all items that must be included on the cover sheet for the project.

1. Sheet Size: Sheet size shall be 24”x36” unless otherwise specified by the Department of Utilities.
2. Project Title: The plat name and phase number, if applicable, shall be included in the project title. If the project will not be platted the physical address shall be used in the project title. All projects that are relocations only must include the word “relocation” in the project title.
3. Signature and Date Lines: Signature and date lines shall be provided for the following personnel:
 - a. City of Lawrence Department of Utilities
 - b. Kansas Department of Health and Environment (KDHE)
 - c. Kansas registered professional engineer (P.E.) responsible for the project.

4. Engineer and Developer Information: The following information for both the engineering firm and registered Professional Engineer preparing the plans and the Developer responsible for the extension or relocation of the sewer main:
 - a. Company Name
 - b. Address
 - c. Phone Number
 - d. Fax Number
 - e. Contact Person
 - f. Contact Email Address

5. General Location Map: A general location map shall be included on the cover sheet. The location map shall show the nearest north-south and east-west arterial streets surrounding the section, township, and range and those in the immediate vicinity of the project area must be shown and labeled. The scale of the vicinity map shall be, at a minimum, 1"=2000'. A north arrow and scale for the map must be noted. The project area shall be labeled and shaded. The section, township, and range where the project is located shall be noted on the general location map.

6. Utility Information: The following information shall be provided for all utilities providing service to the project area:
 - a. Utility Name
 - b. Address
 - c. Phone Number
 - d. Fax Number
 - e. Contact Person
 - f. Contact Email Address

7. Sheet Index: An index for all sheets included in the drawing set shall be provided on the cover sheet.

5503.2 General Plan Layout: This section governs all information to be shown on the General Layout Sheet for the plan set.

1. Sheet Size: Sheet size shall be 24"x36" unless otherwise specified by the Department of Utilities.

2. North Arrow and Scale: A north arrow and scale shall be provided for the General Plan Layout. The preferred drawing scales for the General Plan Layout are 1"=50', 1"=100', or 1"=200' for larger plats.

3. General Elements: The following shall be considered minimum information to be shown on the general layout plan:
 - a. Location of existing and proposed sanitary sewer lines, manholes, and easements/rights-of-way.

 - b. Location of all existing utilities with pertinent information listed as appropriate.

- c. Streets and paved areas shall be identified and labeled as appropriate.
 - d. On site parcels and buildings shall be shown and labeled as appropriate. Buildings not requiring sewer service shall be noted “Service Not Required”.
 - e. Surrounding parcels shall be identified by plat name, phase, and lot/block number. If surrounding parcels are unplatted they shall be identified as “Unplatted”.
 - f. All storm sewers, water courses, detention or retention basins and 100-year floodplain boundaries must be shown and labeled as applicable. For drainage-ways the centerline and top of bank must be shown and labeled. For detention or retention basins the maximum and normal water surface elevations and elevation outlines must be clearly shown and labeled. For detention basins a “dry bottom basin” note must be included to indicate the basin will not retain water after the storm event routing has been completed. The limits of the dam structure for any basin must be shown and labeled. Boundaries and elevation for the 100-year floodplain must be clearly delineated and labeled.
4. Project Control Points: A minimum of two (2) permanent benchmarks and a minimum of three horizontal control points shall be referenced for the project. All benchmarks and control points shall include a verbal description and the location of project benchmarks and control points shall be noted on the general layout sheet. Method used to obtain topographic must be described (ie. Ground survey, LIDAR, etc.) All points shall be surveyed in State Plane Kansas (feet), NAD 83 for horizontal control and NAVD 88 for vertical control. If the Kansas State Plane Datum is modified the appropriate combined adjustment factor and grid to ground scale factor must be included. All benchmarks and control points must be verified by the Department before construction notice to proceed is issued.
5. General Notes: The general notes shall include, at a minimum, the following:
- a. Plans are initially approved for a period of one (1) year, after which they automatically become void and must be updated and re-approved by the City before any construction will be permitted.
 - b. The City of Lawrence plan review is only for general conformance with City of Lawrence Design Criteria and City code. The City of Lawrence is not responsible for the accuracy or adequacy of the design. The City of Lawrence through the approval of this document assumes no responsibility other than stated above for the completeness and/or accuracy of this document.
 - c. The Contractor shall have one (1) signed copy of the plans (approved by the City of Lawrence) with a state approval stamp on the title sheet and one (1) copy of the current Construction and Material Specifications for sanitary sewers on-site at all times during construction.
 - d. The City of Lawrence Technical Specifications, latest edition, and City of

Lawrence Construction and Material Specifications Section 2500 – Sanitary Sewers (8” to 18” Mains), latest edition, shall govern construction of this project.

- e. Contractor shall not be allowed to work Sundays. Holiday or Saturday work shall be as approved by the Department of Utilities.
- f. The utility information shown herein is based on the best information available to the Engineer; however, all utilities actually existing may not be shown. The Contractor shall verify all utility depths and locations prior to construction, and coordinate any necessary relocations. Utilities damaged through the negligence of the Contractor to obtain the location of same shall be repaired and replaced by the Contractor at no additional expense to the project.
- g. Contractor shall call 1-800-DIG-SAFE prior to any project excavation.
- h. Where existing utilities and service lines are to be encountered, the Owner thereof shall be notified by the Contractor at least 48 hours in advance of performing any work in the vicinity.
- i. Relocation of any water line, sewer line or service line thereof required for the construction of this project shall be the responsibility of the Contractor and shall be at his expense.
- j. The Contractor shall maintain drainage during construction and is responsible for any dewatering necessary during construction.
- k. All signing, barricades, and drums utilized in traffic control shall be provided, erected, and maintained by the Contractor. Traffic control shall be in conformance with the Manual of Uniform Traffic Control Devices (MUTCD), latest edition.
- l. All water required for the construction of this project shall be purchased from the City of Lawrence Utilities Department through the use of a fire hydrant water meter. Meters can be obtained from the Utility Department for a nominal deposit, refundable upon the return of the meter.
- m. Construction staking is to be provided by the Contractor. Survey stakes, benchmarks, and property pins destroyed by the Contractor shall be replaced at Contractor’s expense.
- n. All areas disturbed during construction shall be fertilized, seeded, and mulched by the Contractor in accordance with current City of Lawrence Technical Specifications, latest edition.
- o. All surface features disturbed by construction activities shall be restored by the Contractor to original condition.
- p. When blasting is permitted by Lawrence-Douglas County Fire and Medical Services, the Contractor shall use the utmost care to protect life and property. The Contractor shall comply with all laws, ordinances, and the applicable safety code

requirements and regulations relative to the handling, storage and use of explosives and protection of life and property, and he shall be responsible for all damage thereto caused by his or his subcontractor's operations.

- q. The Contractor shall provide insurance as required by the General Provisions and Covenants and Special Project Specifications before performing any blasting. The governing agency shall be notified at least 24 hours before blasting operations begin.
 - r. In areas to be graded for street and storm improvements, all exposed manholes shall be backfilled to within 1' of the top of rim at a 3:1 (horizontal:vertical) maximum slope. Backfill to be placed per City specifications. Positive drainage shall be maintained away from manholes.
 - s. The Contractor shall install and properly maintain a mechanical plug at all connection points with existing lines until such time that the new line is tested and approved.
 - t. During a period of one year from the date of acceptance by the City, the City shall perform a video inspection on the sanitary sewer line installed under this contract. Per resolution number 5614, or latest update, an inspection fee is required for this service. Contractor shall be responsible for all repairs needed as determined from the video inspection.
 - u. Inspection fees are to be paid by the developer.
6. Summary of Quantities: A summary of quantities for the project shall be provided and shall include all items of work for the project. It is recommended that the summary of quantities include, at a minimum, the items listed in Section 2512.5 of the City of Lawrence Construction and Material Specifications Section 2500 - Sanitary Sewers (8" to 18" Mains).
7. Legend: A legend of standard drawing symbols, linetypes, etc. shall be included on the general layout plan.

5503.3 Plan and Profile

1. This section governs all information to be shown on the Plan and Profile sheets for the plan set. The horizontal alignment is examined for conflicts or access restrictions, service availability to all lots and buildings, and the needs of the entire tributary area (watershed or sewershed). The vertical alignment is reviewed for depth, protection of the main at creeks and water courses, minimum and maximum cover, conflicts with other underground utilities, maintaining hydraulic gradients, general location of other sewerage and storm water facilities and other issues. These standards are intended to minimize the need for future extensions or realignments and excessive maintenance of the sanitary sewer.
2. General Requirements:

- a. Show and label the proposed and existing sanitary sewer mains, easements, and service line stubs.
 - b. Show and label all structures such as retaining walls, trash enclosures, carports, separate garages, signs, subdivision monuments, etc..
 - c. Show and label all existing utilities.
 - d. Plan/Profile view(s) of existing main(s) must be shown and labeled in the plan set for those lots or parcels to be served by existing main(s).
 - e. Sheet size shall be 24"x36" unless otherwise specified by the Department of Utilities.
 - f. Label all concrete encasements as "reinforced concrete encasement".
 - g. Label the beginning and ending stationings of reinforced concrete encasements on the main in the profile view and on stubs in the plan view. The stationings of the reinforced concrete encasement may be rounded to the nearest foot.
3. Existing and Proposed Streets and Rights-of-Way:

- a. Label the name for all existing and proposed streets. All paved areas must be shown and identified as necessary.
- b. Show and label all street right-of-way in the vicinity of the sewer main. Label the width of the right-of-way for streets and the radius of the right-of-way at cul-de-sacs.
- c. Label all private drives as "private". The "private" label must be included with the street name as applicable. Drives that are private and will not be named must be labeled as "private drive".

4. Existing and Proposed Grade:

- a. Show and label the existing and proposed ground profiles along the centerline of the sanitary sewer main. Show existing profiles as a dashed line and proposed profiles as a solid line.
- b. If the proposed grade equals the existing grade, label the grade as "Proposed Grade = Existing Grade".
- c. Where the top of the proposed main is three (3) feet or less from the existing ground surface, provide the following note: "Compacted fill must be placed to a minimum height of three (3) feet above the top of the proposed sewer main prior to the installation of the main." Show and label the compacted fill to be placed in the profile.

5. North Arrow and Scale:

- a. Provide a north arrow and horizontal and vertical drawing scales. Preferred scales are 1" = 20' horizontal and 1"=5' vertical. The minimum allowable drawing scale is 1" = 50' horizontal and 1"=10' vertical.

6. Reference to Project Control:

- a. Show and label project and temporary benchmarks in the plan view as applicable.
- b. Show and label all horizontal control points in the plan view as applicable.

7. Lot or Property Lines:

- a. Label all lot numbers, tracts, and block numbers, if applicable. Property lines and lot lines shall be shown and a draft copy of the final plat provided for each labeled reference.
- b. Unplatted parcels shall be labeled as "unplatted".
- c. For projects other than single family residential, label all buildings with a unique designation or number and where applicable label units within the building.
- d. Label all surrounding areas served by this main extension with the plat name and lot number or as "unplatted". Do not provide lot numbers for unplatted future lots. Label those lot areas as "unplatted" or "future platting".
- e. Show and label the building setback lines for residential projects.

8. Existing and Proposed Utilities:

- a. All existing and proposed utilities shall be shown in the plan and profile views, as applicable. Specific crossing requirements shall be noted on the plans for each affected utility.
- b. Label the existing and proposed sewer pipe size, slope, and length.
- c. Label the existing and proposed manholes. Existing manholes shall be referenced by the City of Lawrence Facility ID which can be obtained from the GIS interactive map located at

<http://gis.lawrenceks.org/viewer/index.html>
- d. In the event that the Facility ID is not available, existing manholes may be identified by their original designation as shown on the as-built drawings for the project.

9. Creek and/or Watercourse Crossings

- a. Show and label the centerline and top of banks for all creeks and/or watercourses, existing or proposed, for the project in plan and profile views.
- b. Protection of the sewer main, as required, shall be clearly identified on both the plan and profile view.

10. Detention and Retention Basins:

- a. Show and label all existing or proposed water detention or retention facilities including dam structure limits. For retention and detention basins the maximum and normal water surface elevations and elevation outlines must be clearly shown and labeled.
- b. For detention basins, a note must be included to indicate whether the detention basin will or will not retain water after the storm event routing has been completed, i.e. if it is a “dry” or “wet” basin.

5503.4 Details

1. This section governs all information to be shown on the Standard Details for the plan set.
2. Sheet size shall be 24”x36” unless otherwise specified by the Department of Utilities.
3. Details for the project shall be City of Lawrence Standard Details. Additional details required for the project shall be reviewed and approved on a case by case basis by the Department of Utilities.

5503.5 Drafting Standards:

1. General: While the construction drawings are used primarily for construction, the project drawing as-builts are the permanent record of the City of Lawrence wastewater system. The information provided on these drawings is also used for additional extensions to the system, system modeling, system maintenance, and is used in providing location services under the one call system. This information is used by engineers, developers, contractors, builders, architects, and the public in general. It is critical for the long term management of the wastewater system that the information provided on these drawings be accurate and clearly shown.
2. General Drafting Requirements:
 - a. All sheets in the plan set shall be 24”x36” unless otherwise specified by the Department of Utilities.
 - b. A single plan/profile view format for each sheet shall be used for each plan and profile sheet. A plan view is required for each profile on the same sheet. The profile should be located immediately under the corresponding plan view.

- c. Stationing must begin at the downstream end of the proposed main.
- d. Stationing shall increase from left to right across the plan sheet.
- e. Stationing shall be indicated at 100 foot intervals in both plan and profile views.
- f. Elevations shall be provided in the profile view at a minimum of 10 foot intervals. The elevation grid label shall be placed on the horizontal grid line instead of in the middle of the grid line.
- g. Labels shall be positioned as close as possible to the feature they are identifying without conflicting with other lines. Text overwrites are not permitted.
- h. Revisions to plans that have been released for construction shall be clouded and checked with an explanation of the change included in the revision. All revisions to previously approved plans shall be approved by the City of Lawrence Utility Department prior to construction.

SECTION 5504 DESIGN REQUIREMENTS

5504.1 Design Flow Rates:

- 1. Design flow rates shall be calculated based on total acreage of the development, weighted average density, per capita usage, and estimated infiltration and inflow.
- 2. A spreadsheet is available for download that allows the user to input acreage, density, and interpolation information and calculates the design flow for the development. The spreadsheet can be downloaded from

http://www.lawrenceks.org/utilities/technical_resources

Per capita usage, infiltration and inflow, time of concentration, flow intensities, and peaking factors are based on data from the City of Lawrence 2003 Wastewater Master Plan. An Example is provided in Attachment A of these criteria.

5504.2 Pipe Requirements:

- 1. Pipe Size: Pipes shall be sized to provide adequate capacity in accordance with section 5504.1 of these criteria. The minimum pipe diameter shall be eight (8) inches.
- 2. Pipe Slope: Pipe slope shall be as follows for eight (8) inch diameter sewer mains:

Calculated Design Flow (gpm)	Minimum Slope
0-70	1.00%
71-141	0.80%
142 or more	0.64%

For pipe larger than eight (8) inches in diameter the slope shall provide a minimum velocity of two (2) feet per second when flowing half full. The following table indicates the minimum permissible slopes for this condition.

Minimum Pipe Slopes

Pipe Diameter (in)	Hydraulic Radius (ft)	Minimum Slope (%)
10	0.208	0.248%
12	0.250	0.194%
15	0.313	0.144%
18	0.375	0.113%

All public sewers should be designed such that the mean velocity does not exceed ten (10) feet per second when flowing full. The following table indicates the maximum permissible slopes for this condition.

Maximum Pipe Slopes

Pipe Diameter (in)	Hydraulic Radius (ft)	Maximum Slope (%)
8	0.167	8.344%
10	0.208	6.197%
12	0.250	4.860%
15	0.313	3.609%
18	0.375	2.830%

3. Where pipe velocities are greater than ten (10) feet per second special provisions shall be made to protect against erosion. Methods shall be approved on a case by case basis by the Department of Utilities.
4. Pipe Anchors: Where pipe slopes exceed 15% and manhole spacing exceeds one hundred (100) feet, special provisions shall be made to anchor the pipe securely as described in Section 2506.2.11 of the City of Lawrence Construction and Material Specifications Section 2500 – Sanitary Sewer (8” to 18” Mains).
5. Pipe Angles: The interior angle between incoming and outgoing lines for both existing and new mains shall be clearly labeled at all manholes in the plan view in ddmms format. Interior angles less than ninety (90) degrees shall not be acceptable under any circumstance.

6. Minimum Cover: A minimum of thirty (30) inches of cover is required over the top of the main and service stubs in all locations.
7. Pipe Protection:
 - a. Retaining Walls: Where retaining walls are proposed over or near existing or proposed mains or service lines, the main or service line shall be encased in reinforced concrete or installed in a steel casing pipe conforming to the requirements set forth in section 2506.4 of the City of Lawrence Construction and Material Specifications Section 2500 – Sanitary Sewer (8” to 18” Mains). Encasement or casing pipe protection shall extend a minimum of five (5) feet either side of the retaining wall. Walls, footings, or keys shall not bear directly or indirectly upon the encasement or casing pipe and shall not parallel the main within the easement.
 - b. Pipeline and Highway Crossings: Where the sanitary sewer main crosses an existing highway or pipeline, the main shall be installed in a steel casing pipe conforming to the requirements set forth in section 2506.4 of the City of Lawrence Construction and Material Specifications Section 2500 – Sanitary Sewer (8” to 18” Mains). Casing pipe protection shall extend, at a minimum, to the limits of the pipeline easement or highway right-of-way. Pipe protection requirements as listed above are considered a minimum requirement. When crossing details and specifications are published by the respective governing authority, pipe protection shall conform to the more restrictive requirement.
8. Pipe Depth: The depth of sewers generally shall be limited to twenty (20) feet as measured from flowline of pipe to finished grade. Exceptions to this requirement will be made on a case by case basis and only if no other feasible alternatives exist. In general, exceptions will not be approved if the sole purpose of the extra depth is to provide service to areas outside the watershed or sewershed to be served by the project.
9. Larger Diameter Mains: For gravity mains and force mains greater than eighteen (18) inches and six (6) inches respectively the Design Engineer shall submit type of pipe proposed for approval by the Department of Utilities. Along with this submittal the Design Engineer shall evaluate and compare the proposed pipe specifications to the City Technical Specifications and Design Criteria for Sanitary Sewer Mains. Where specifications differ from the City’s standard specifications the engineer shall supply the City with a detailed list of the differences for review.

5504.3 Manhole Requirements:

1. Manholes shall be required at all changes in horizontal and vertical alignment and at all changes in pipe size and pipe material. Curved alignments, cleanouts and lampholes will not be permitted. Existing sanitary sewer cleanouts and lampholes within the limits of the project shall be removed in design and replaced with a manhole.

2. Typical manhole spacing shall be 400 feet. Greater spacing may be approved by the Department of Utilities on a case by case basis.
3. Manholes shall be located a minimum of ten (10) feet beyond the top of bank when adjacent to a watercourse.
4. Wall thickness for manholes less than sixteen (16) feet deep shall be 1/12 of the internal shell diameter or four (4) inches, whichever is greater. For manholes sixteen (16) feet or greater in depth the wall thickness shall be 1/12 of the internal shell diameter plus one (1) inch or five (5) inches, whichever is greater.
5. The minimum diameter for manholes shall be four (4) feet.
6. The minimum depth for manholes, from the rim to the lowest invert, shall be four (4) feet.
7. A minimum drop of 0.20 feet or, at locations where a change in pipe size occurs, the difference in pipe diameter, is required across all manhole inverts.
8. Drop manholes shall be used if the difference in invert elevations is equal to or greater than twenty four (24) inches. Only inside drop manholes shall be permitted. The minimum diameter of a drop manhole shall be five (5) feet.
9. Manholes located on interceptor sewer lines, force main receiving manholes, or other manholes, as determined by the department of Utilities, shall have the interior surface lined with an epoxy or polyurethane system installed per manufacturers' recommendation, conforming to section 2510.3.3 or 2510.3.4 of the City of Lawrence Construction and Material Specifications Section 2500 – Sanitary Sewer (8” to 18” Mains).

Requirements 10 through 12 shall apply to the following:

- Manholes located within the FEMA delineated 100-year floodplain.
 - Manholes within the limits of the 100-year water surface elevation of natural watercourses. Manholes adjacent to manmade watercourses may be subject to these guidelines and will be reviewed on a case by case basis by the Department of Utilities.
 - Manholes adjacent to detention/retention or storm water impoundment areas.
10. Manholes shall be installed with bolt down gasketed lids conforming to the provisions of Section 2510.3.8.a of the City of Lawrence Construction and Material Specifications Section 2500 – Sanitary Sewer (8” to 18” Mains).
 11. Manholes shall maintain a rim elevation of at least two (2) feet above the 100-year water surface or flood pool elevation.

12. All joints in manholes shall be sealed. Sealant shall conform to Section 2510.3.5 of the City of Lawrence Construction and Material Specifications Section 2500 – Sanitary Sewer (8” to 18” Mains).

5504.4 Service Line Requirements:

1. A service connection stub out shall be provided for each lot and/or building. The service stub is provided on the main to accommodate connection of the building service line.
2. The building service line shall generally be less than 200 feet in length. A minimum of five (5) feet of separation shall be provided between the end of the stub and the building.
3. Service lines shall extend a minimum of five (5) feet into the lot to be served. In addition, the service line shall extend through all easements and/or rights-of-way that may contain other utilities.
4. A service line for a lot shall generally not cross another lot to access the sewer main. The service line for a lot may enter another lot only if the other lot is contiguous with or located immediately across the street right-of-way from the lot to be served. The service line entering another lot shall be located only in the sanitary sewer easement or utility easement for the sanitary sewer main.
5. Service lines shall not cross watercourses, wetland areas or any basins including detention or retention areas.
6. If an existing or proposed building will not require sanitary sewer service, provide the following label on the building: **SEWER SERVICE NOT REQUIRED**. A written explanation of why service is not required must be submitted.
7. When a project includes multi-unit buildings such as duplex, 3-plex, 4-plex buildings, etc. or other commercial buildings located on a common lot, a service line stub shall be provided for each unit. Single service stubs to multi-unit buildings located on a common lot are permissible provided that a homeowners, tenants or other form of community association is formed or in existence and will be responsible for the maintenance of the single service lines.
8. Connections shall be provided for all future lots or buildings. For lots with an existing main and no connection, the connection shall be made utilizing a tee or wye service saddle. Service connections will not be permitted on sewer mains larger than twelve (12) inches in diameter.
9. Manhole stubs are not permitted without the approval of the Department of Utilities.
10. Connections shall be a minimum of five (5) feet apart and shall not be installed in the same trench.

11. All tee or wye service connections must be installed at a minimum of 45 degrees from horizontal
12. The minimum slope for a six (6) inch service line shall be 1.00%. The minimum slope for a four (4) inch service line shall be 2.00%.
13. For stubs to be installed on a sewer main running between two lots, stubs shall be located in front of the front building line or a minimum of fifty (50) feet behind the front building line to avoid connections between foundations.
14. End of stub locations shall be identified by station and offset referenced to the sewer main.
15. The flow line elevation of the upstream end of the service stub shall be labeled in the plan view.
16. Risers are required when the depth of the end of the stub exceeds five (5) feet.
17. For all buildings and/or lots to be serviced by the sewer main minimum serviceable floor elevations (MSFE) shall be provided. A distance of three feet between the floor elevation and the flow line of the main at the connection is considered the minimum vertical clearance provided for connection. This clearance must be increased to account for service line length, depth of the lot, and other site specific circumstances.

5504.5 Potable Waterline Separation Requirements:

1. Horizontal Separation:
 - a. A minimum of ten (10) feet horizontal separation, as measured from the outside edge to outside edge, shall be required between a sanitary sewer main, forcemain, service line, or manhole and potable waterline.
 - b. Under no circumstance shall potable waterline and sanitary sewer be placed in the same trench.
 - c. Sanitary sewers shall meet the minimum separation requirements from public water supply wells or other water supply sources and resources as set forth by the appropriate reviewing agency.
2. Vertical Separation:
 - a. A minimum of two (2) feet vertical separation, as measured from the outside walls of the pipe, shall be required between a sanitary sewer main or service line and potable waterline.
 - b. In general sanitary sewer lines shall be located below potable waterlines.

- c. Sanitary sewer force mains shall always be located below potable waterlines and shall maintain a minimum of two (2) feet of vertical separation, as measured from the outside of the walls of the pipe.
3. Protective Measures: When sanitary sewers and potable waterlines cross with less than two (2) feet of vertical clearance, and in all cases where the potable waterline, is located below the sanitary sewer, additional measures must be employed to protect the potable waterline.

Acceptable measures include:

- a. Construction of the sanitary sewer line using one of the following materials:
 1. Ductile iron pipe conforming to ASTM A536 or ANSI/AWWA C151/A21.52 with a minimum thickness class 50, and gasketed, push-on, or mechanical joints in conformance with ANSI/AWWA C110/A21.10 or ANSI/AWWA C111/A21.11.
 2. PVC pipe conforming to ASTM D3034 with minimum wall thickness of SDR41, ASTM F679, or ASTM F794, with gasketed push-on joints in conformance with ASTM D3215.
 3. Reinforced concrete pipe conforming to ASTM C76 with gasketed joints in conformance with ASTM C361 or ASTM C443.

Install a minimum twenty (20) foot length of sanitary sewer pipe on the crossing to maximize the joint spacing to a minimum of ten (10) feet from the crossing.

- b. Provide concrete encasement of the sanitary sewer line a minimum of six (6) inches in thickness for a minimum distance of ten (10) feet either side of the pipeline crossing.
- c. Sanitary sewer service lines may be constructed using schedule 40 PVC pipe with solvent welded joints. Pipe joints shall be located a minimum of ten (10) feet either side of the pipeline crossing.

5504.6 General Utility Separation Requirements:

1. Horizontal Separation: A minimum of five (5) feet of horizontal separation, as measured from outside walls of the pipe, shall be required between all utilities, excluding potable waterlines, and sanitary sewer main, forcemain, service line or manhole.
2. Vertical Separation: A minimum of two (2) foot of vertical separation, as measured from the outside walls of the pipe, shall be required between all utilities and sanitary sewer main, forcemain or service line.

5504.7 Abandonments:

1. Gravity and Pressure Pipeline: Gravity and pressure pipeline shall be plugged and filled with flowable fill or cement mortar.
2. Manholes: Manhole cones or the top four (4) feet shall be removed, penetrations shall be plugged and grouted, and the manhole shall be filled with flowable fill if under pavement or sidewalk, otherwise the manhole shall be filled with sand.
3. Manhole Connections: Manhole connections shall be cut, plugged and grouted within two (2) feet of the manhole.
4. Service Lines: Service lines shall be cut and plugged within eighteen (18) inches of the sanitary sewer main and the cap shall be encased in concrete.

SECTION 5505 ALIGNMENT AND LOCATION

5505.1 General:

1. Sanitary sewer alignments shall be designed to minimize pipe depth, length of main and service lines, and the number of manholes required.
2. Sanitary sewer alignments shall be designed such that the requirements of City of Lawrence Code Section 19-214 can be met.
3. Sanitary sewer shall generally be located along rear lot lines within a permanent easement.
4. Sanitary sewer mains shall not be located in public right-of-way unless approved by the Department of Utilities.
5. Where sanitary sewers are installed in easements on rear lot lines the sewer shall not terminate after the last shared lot line, but shall extend to the adjacent street right-of-way and terminate with a manhole to provide access for maintenance purposes.
6. All sewers shall be designed on straight alignments between manholes, curved alignments are not permitted.
7. Sanitary sewer shall be located a minimum of fifteen (15) feet from any building structure and a minimum of eight (8) feet from all other structures. Structures of any kind shall not be located within the sanitary sewer easement limits.

5505.2 Watercourse Crossings:

1. Aerial crossings shall not be permitted.
2. Inverted siphons shall not be permitted.

3. Sanitary sewers crossing watercourses shall be designed to cross the watercourse as nearly perpendicular to the flow direction as possible and shall be on a constant grade.
4. Sanitary sewer systems shall be designed to minimize the number of stream crossings.
5. Protection of the sanitary sewer main shall be provided at all watercourse crossings as required to prevent erosion.
6. If the depth of cover over the main is five (5) feet or less, reinforced concrete encasement, casing pipe, or other protective measure as appropriate shall be provided extending the full width of the watercourse crossing to a point ten (10) feet beyond the top of bank.
7. Impervious ditch checks, as detailed on the standard drawings, shall be provided immediately downstream of the watercourse crossing.

5505.3 Detention and Retention Basins:

1. Sanitary sewer mains or service lines shall not run through a detention or retention facility.
2. All existing and proposed sanitary sewer mains or service lines shall be located a minimum of two (2) feet horizontally away from the edge of the maximum water surface elevation for each foot of depth of the sanitary sewer main.
3. An impervious ditch check, as detailed on the standard drawings, shall be provided immediately downstream of any detention or retention basin.

SECTION 5506 EASEMENT REQUIREMENTS

5506.1 General:

1. All sanitary sewer lines must lie in either a platted utility or sanitary sewer easement or a utility or sanitary sewer easement dedicated to the City of Lawrence, Kansas.
2. A standard utility easement is provided as Attachment B of these criteria.
3. A standard temporary construction easement is provided as Attachment C of these criteria.
4. When easements are to be dedicated by separate instrument, draft easements shall be submitted for review with the first intermediate plan submittal. The entire easement form including legal description and an exhibit map shall be provided.
5. Plans will not be released for construction until the signed easements and/or recorded final plat have been received by the City of Lawrence.

5506.2 Easement Width Requirements:

1. Permanent easements for sanitary sewer mains shall be centered on the main.
2. Permanent easements for sanitary sewer mains shall be a minimum of fifteen (15) feet in width.
3. Permanent easements shall increase in width according to pipe depth as follows:

Depth to Invert	Easement Width
0 to 10 feet	15 feet
11 to 15 feet	20 feet
16 to 20 feet	30 feet

4. Sewer depths generally shall not exceed twenty (20) feet per section 5504.2 of these criteria. In such cases where the pipeline depth exceeds twenty (20) feet, easements shall be submitted for review and approval by the Department of Utilities.
5. Easements shall extend beyond the center of a terminating manhole a distance equal to one half of the required easement width as determined from the above table.

5506.3 Standard Easement Forms:

1. Permanent Utility Easement:
 - a. The permanent easement form is included as Attachment B of these criteria.
 - b. The easement form shall be completed and executed prior to the release of plans for construction.
 - c. A written legal description shall be included with the easement form as Exhibit "A".
 - d. An easement exhibit shall be included with the easement form as Exhibit "B".
 - e. The grantor signature line must be completed by an individual owner, a president, vice president, or authorized representative of a corporation, or a member or manager for a limited liability company or by trustee(s) of a trust. The grantor's ownership name must be accurate in all aspects as would be required for a deed transfer.
2. Temporary Construction Easement:
 - a. The temporary construction easement is included as Attachment C of these criteria.

- b. The easement form shall be completed and executed prior to the release of plans for construction.
- c. A written legal description shall be included with the easement form as Exhibit “A”.
- d. An easement exhibit shall be included with the easement form as Exhibit “B”.
- e. The grantor signature line must be completed by an individual owner, a president, vice president, or authorized representative of a corporation, or a member or manager for a limited liability company or by trustee(s) of a trust. The grantor’s ownership name must be accurate in all aspects as would be required for a deed transfer.

5506.4 Platted Easement Requirements:

- 1. Easement dedication of platted easements to the City of Lawrence shall be included on the plat.
- 2. Utility easements shall be clearly delineated on the plat and shall be clearly labeled throughout. Irregular easement shapes shall require dimensional labeling sufficient to clearly determine the easement limits such that any land surveyor can locate and stake the easements in the field.

5506.5 Off-Site Easements:

- 1. Projects may require the acquisition of temporary and/or permanent utility easements. It is the responsibility of the Developer or Engineer to obtain all required easements.
- 2. Efforts to acquire any required off-site easements must commence as soon as the alignment of the pipeline is set and draft easements have been approved.
- 3. All offers to the affected property owner shall be made in writing and sent to the property owner as certified mail with return receipt requested. The City of Lawrence should be copied on all correspondence with affected property owners.
- 4. If the developer has demonstrated reasonable effort to acquire an off-site easement and the affected property owner refuses to execute the easement, the following remedies may apply:
 - a. If the main extension is to service the adjoining property exclusively, the affected property owner must deny the easement in writing and specifically decline their right to direct sanitary sewer access. Full documentation of all acquisition efforts must be presented to the City of Lawrence before this option may be considered.
 - b. If the main extension must cross an off-site property to serve the project property, the use of eminent domain (condemnation) may be proposed. The use of eminent domain is the method of last resort when all efforts to negotiate/purchase the

offsite easements have been unsuccessful. Full documentation of all acquisition efforts must be presented to the City of Lawrence before eminent domain (condemnation) may be considered. All costs associated with eminent domain proceedings shall be paid by the developer. Payment of these costs may need to be secured by an escrow account, non-revocable letter of credit or other means.

Attachment A
Design Flow Example

Design Flow Example:

Develop the design sanitary sewer flow rate for a development with the following characteristics:

Land Use:

- 10 ac medium density residential
- 6 ac office/multi family
- 4 ac office/commercial

Solution:

- Step 1. Input the land use acreages into column A of the Land Use sheet as shown.
- Step 2. Input the density into column E of the Land Use sheet as shown.
- Step 3. Input the bounding values from the Design Table for developed acreage in column B of the Design Flow sheet as shown.
- Step 4. Read the design flow as calculated in column N of the Design Flow Sheet as shown.

DEVELOPMENT LAND USE INPUT

Input Area Zoned decimal	Calculated Percent Type	Zone Land Use	Density Description	Equivalent units/acre	Input Equivalent capita/unit	Given Equivalent capita/acre	Calculated Capita Usage Capita	Calculated Average gal/capita/day	Given WWP gal/acre/day	Calculated Infiltration gal/acre/day	Given Inflow gal/acre/day	Given Coeff K
0	0.00	1	Very Low Density Res		1.0	2.3	2.3	0	100	230	500	0.0035
0	0.00	2	Low Density Res		4.0	2.3	9.2	0	100	920	500	0.0035
10	0.50	3	Medium Density Res		12.0	2.3	27.6	276	100	2760	500	0.0035
6	0.30	4	Office//Multi Family		12.0	2.3	27.6	166	100	2760	200	0.0030
4	0.20	5	Office/Commercial		2.0	3.0	6.0	24	100	600	200	0.0030
0	0.00	6	Heavy Industry		1.0	25.0	25.0	0	100	2500	200	0.0030
0	0.00	7	Public		1.0	7.0	7.0	0	100	700	0	0.0005
0	0.00	8	Agriculture/Park		1.0	1.0	1.0	0	100	100	0	0.0005
20	1.00	Calculated Weighted Averages			10.0	2.4	23.3	466	100	2328	350	0.0033

DEVELOPMENT DESIGN FLOW CALCULATION

	Developed Tc 10 Yr i Factor	WWP Inflow	Peak WWP Infiltration	Design Flow	Calculated Design Flow	Calculated ADF	Calculated Peaking	Equivalent Design Flow	Inflow + Peak WWP + Infiltration = Calculated Design Flow (acres)	Calculated (minutes)	Calculated (in/hr)	Calculated Peaking Factor	Calculated Design Flow/ADF (cfs)	Calculated (cfs)	Calculated (mgd)
Lesser value from Design Table	10.00	66.6	2.58	2.00	0.084	0.072	0.005	0.161	0.104	0.023	4.48	233	72		
Results for Development	20.00	69.1	2.58	1.95	0.168	0.141	0.011	0.319	0.206	0.047	4.43	466	143		
Higher value from Design Table	25.00	70.4	2.58	1.93	0.210	0.174	0.014	0.397	0.257	0.058	4.41	582	178		

Lawrence Design Data From 2003 Wastewater Master Plan			
Developed Acres	Tc minutes	10 Yr "i" in/hr	WWP Peaking Factor
1	62.1	2.58	2.17
10	66.6	2.58	2.00
25	70.4	2.58	1.93
50	74.7	2.58	1.88
75	78.1	2.16	1.85
100	80.9	2.16	1.83
250	93.0	1.89	1.76
500	106.6	1.69	1.71
750	117.1	1.69	1.68
1000	126.0	1.54	1.66
1250	133.7	1.54	1.64
1500	140.8	1.40	1.63
1750	147.3	1.40	1.62
2000	153.3	1.30	1.61
2500	164.3	1.30	1.59
3000	174.2	1.21	1.58
4000	191.9	1.13	1.56
5000	207.5	1.13	1.54
7000	234.5	1.00	1.52
7500	240.6	0.90	1.51
10000	268.6	0.90	1.49
50000	526.4	0.53	1.37

Attachment B
Standard Easement Document - Permanent

INDIVIDUAL ACKNOWLEDGMENT

BE IT REMEMBERED, that on this _____ day of _____, 20__, before me, the undersigned, a Notary Public in and for the County and State aforesaid came _____, who is personally known to me to be the same person who executed the within and foregoing instrument of writing, and duly acknowledged the execution of the same.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal the day and year last above written.

Notary Public

My Commission Expires: _____

CORPORATION ACKNOWLEDGMENT

BE IT REMEMBERED, that on this _____ day of _____, 20__, before me, the undersigned, a Notary Public in and for the County and State aforesaid came _____, an authorized agent of _____, a corporation duly organized, incorporated and existing under and by virtue of the laws of the State of _____, who is personally known to me to be such officer, and who is personally known to me to be the same person who executed, as such officer, the within instrument on behalf of said corporation, and such person duly acknowledged the execution of the same to be the act and deed of said corporation.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal the day and year last above written.

Notary Public

My Commission Expires: _____

LIMITED LIABILITY COMPANY ACKNOWLEDGMENT

BE IT REMEMBERED, that on this _____ day of _____, 20____, before me, the undersigned, a Notary Public in and for the County and State aforesaid came _____, of _____ L.L.C., who is personally known to me to be the same person who executed the within and foregoing instrument of writing, and duly acknowledged the execution of the same on behalf of said Limited Liability Company..

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal the day and year last above written.

Notary Public

My Commission Expires: _____

Attachment C
Standard Easement Document - Temporary

INDIVIDUAL ACKNOWLEDGMENT

BE IT REMEMBERED, that on this _____ day of _____, 20__, before me, the undersigned, a Notary Public in and for the County and State aforesaid came _____, who is personally known to me to be the same person who executed the within and foregoing instrument of writing, and duly acknowledged the execution of the same.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal the day and year last above written.

Notary Public

My Commission Expires: _____

CORPORATION ACKNOWLEDGMENT

BE IT REMEMBERED, that on this _____ day of _____, 20__, before me, the undersigned, a Notary Public in and for the County and State aforesaid came _____, an authorized agent of _____, a corporation duly organized, incorporated and existing under and by virtue of the laws of the State of _____, who is personally known to me to be such officer, and who is personally known to me to be the same person who executed, as such officer, the within instrument on behalf of said corporation, and such person duly acknowledged the execution of the same to be the act and deed of said corporation.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal the day and year last above written.

Notary Public

My Commission Expires: _____

LIMITED LIABILITY COMPANY ACKNOWLEDGMENT

BE IT REMEMBERED, that on this _____ day of _____, 20__, before me, the undersigned, a Notary Public in and for the County and State aforesaid came _____, of _____ L.L.C., who is personally known to me to be the same person who executed the within and foregoing instrument of writing, and duly acknowledged the execution of the same on behalf of said Limited Liability Company..

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal the day and year last above written.

Notary Public

My Commission Expires: _____

Attachment D
KDHE Application



STATE OF KANSAS
DIVISION OF ENVIRONMENT
APPLICATION FOR SEWER EXTENSION PERMIT

The applicant hereby requests a permit for extension of sanitary sewers in compliance with the requirements of K.S.A. 65-165 and K.S.A. 65-166. Plans and specifications submitted must comply with the Kansas Department of Health and Environment, Division of Environment, "Minimum Standards of Design for Water Pollution Control Facilities."

APPLICANT DATA

1. _____
Name of Project (as it appears on plans)
2. _____
Name of Applicant (Governmental Unit)
3. _____
Kansas Water Pollution Control Permit Number for the Wastewater Treatment Facility which will treat the flow from this sewer extension.
4. _____
Name the engineer or engineering firm responsible for inspection of this extension.

In making application for a sewer extension permit, I hereby certify that continuous engineering observation of the construction of the proposed improvement, including building connections, shall be provided in accordance with Kansas Department of Health and Environment Regulation 28-16-55.

Signature: _____
Authorized Official

Print Name: _____

Title: _____

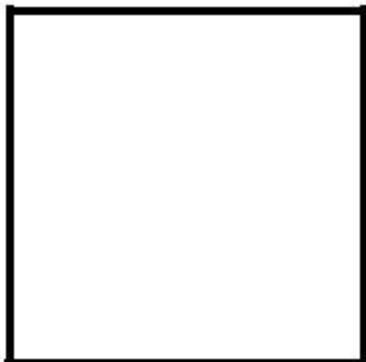
Mailing Address: _____

DESIGN ENGINEER DATA

1. _____
Name of Project (as it appears on plans)
2. Engineers estimate of construction cost _____
3. What are the conditions and capacity of the existing sewer system downstream of this sewer extension?
 - a. What is the present average daily flow at the wastewater treatment facility? _____ MGD
CIRCLE YES OR NO
 - b. Do the downstream sewer lines presently convey the peak flow without inducing backup into buildings or bypass to the environment? YES NO
 - c. Can the downstream receiving sewers convey the additional peak design flow generated after completion of this sewer extension without backup into buildings or bypassing to the environment? YES NO
 - d. If the answer to either of the above questions is NO, what steps are being taken to eliminate or prevent bypass or service line backup conditions?

Attach additional pages if necessary.
4. What are the design flows for this sewer extension?
(Include a copy of the calculations for flow and list the following values)
Average daily _____ MGD Peak _____ MGD
5. If wastewater pumping facilities are included in the project, provide with this application the following: system curve, pump curve and total head calculations and planned control elevations i.e. pumps off, low level on, high level on, and alarm level.

The information contained above is accurate to the best of my knowledge.



Signature: _____
Kansas Licensed Engineer

Print Name: _____

Address: _____

P.E. Stamp/Date/Signature