City of Springfield, Missouri

Design Standards for Public Improvements

Adopted: 11/01/2017

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Director of Public Works

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2 PLAN PREPARATION

2.1 DRAWING STANDARDS

2.1.1 General. Drawings for all submissions shall be submitted electronically. Final approved drawings will be stamped and filed electronically and will be available for download after all requirements have been met and fees are paid. After filing, the original drawings shall become the property of the City of Springfield. Drawings to comply with latest electronic document submittal standards as follows:

2.1.1.1 Utilities. All utilities must be contacted as necessary by applicant.

2.1.1.2 State Highways. Projects involving state highways will require the approval of the Missouri Highway and Transportation Department.

2.1.1.3 Standard Plan File Naming Standards.
The sheet number suffix must be preceded by the public improvement plan number. Sheet numbers are to be sequentially numbered. Example public improvement plan number: 2010PW0155; where 2010 is the year designation and 155 is the 155th public improvement plan for that year.

Discipline	Name	Sheet ID	Sheet Number	Example File Names
Street/Traffic/Sidewalk	2010PW0155	T	001-999	2010PW0155T1
				2010PW0155T2
				2010PW0155T3
Stormwater	2010PW0155	W	001-999	2010PW0155W1
				2010PW0155W2
				2010PW0155W3
Sanitary Sewer	2010PW0155	S	001-999	2010PW0155S1
				2010PW0155S2
				2010PW0155S3
Erosion Control	2010PW0155	E	001-999	2010PW0155E1
				2010PW0155E2
				2010PW0155E3

The file name shall be shown on the title block. For filing purposes the plans can be filed as 2010PW0155TSWE indicating that these plans include street, stormwater, sanitary sewer, and erosion control improvements.

2.1.1.4 Border Standards. All Drawing Files shall use the downloadable City of Springfield Public Works title block for all drawings

2.1.1.5 File Type Standards.

- Only searchable PDF files are accepted for calculations, reports and other supporting documentation (non-drawing files).
- Both vector PDF and Design Web Format (DWF) files will be accepted for drawing files. Since AutoCAD software is commonly used to create drawing files, converting a DWG to DWF file print ready is the preferred secured file format. Files must be 2D DWF file print ready, i.e. setup properly for printing with title block, no extra data outside the print page area, etc. The DWF must be saved as AutoCAD version 10 or lower format. ProjectDox does not support 3D DWF files.
- If you choose to create PDF files, you will need to convert your AutoCAD files to a vector PDF by using AutoDesk Vector Graphic Converter "DWG to PDF.pc3 Plotter Driver."
- Confirm that the lines are dark by changing the background to grayscale prior to saving each page as a separate DWF file with correct pen widths for printing.

2.1.1.6 Electronic Stamps and Signature.

- All files must be electronically stamped with signature per Missouri Statues and Missouri Administrative Code. There are specific provisions for electronic signatures within the Rules and Regulations. Architects and Engineers are responsible for compliance to the rules.
- Electronic stamps and signatures must be inserted images on DWG files.
- Go to http://www.springfieldmo.gov/1101/Developer-Resource-Center for electronic document submittal standards.

2.1.2 Drawing Scale. Engineering plan and profiles shall be prepared on a scale of 1" = 40' horizontal and 1" = 4' vertical. When requirements for detail necessitates a larger scale, a horizontal scale of 1" = 20' and 1" = 4' vertical, may be used. Drainage area maps, construction details, cross sections, and contour maps shall be drawn to a scale suitable to show complete detail.

2.1.3 Elevation Datum. Elevations shown on plans shall be in the North American Vertical Datum of 1988. At least one National Geodetic Survey (NGS) or City of Springfield (COS) benchmark shall be used to establish the project datum. At least one project benchmark shall be established on site or near the site. The project benchmark will be semi-permanent in nature and not easily disturbed. The NGS or COS benchmark used and the project benchmark established shall be noted on the first plan sheet of each project, and their location and elevation shall be clearly defined.

2.1.4 Stationing and North Arrow. The top of each plan sheet shall be either north or east, and a standard north arrow should be used.

The stationing on street plans and profiles shall be from left to right, but on drainage, sanitary sewer, and storm sewer plans, the stationing shall always begin at the low point.

2.1.5 Topography. When more than one drawing sheet is required for a project, an overlap of not less than 100 feet shall be provided.

Each project shall show at least 100 feet of topography on each side. Subdivision plans shall show at least 100 feet of topography outside the plat limits. All existing topography and any proposed changes, including utilities, telephone installations, etc., shall be shown on both the plan and profile portion of the drawing.

2.1.6 Revisions to Drawings. Revisions to drawings shall be noted on the plan above the title block and shall show the nature of the revision and the date made.

2.1.7 Symbols. Typical symbols shall be used in the preparation of engineering drawings. Topography for which symbols have not been standardized shall be indicated and named on the plan and profile sheet. In utilizing the standard symbols for engineering plans, all existing utilities, telephone installations, sanitary and storm sewers, pavements, curbs, inlets, and culverts, etc., shall be shown with a broken line; proposed facilities with a solid line; land, lot, and property lines to be shown with a slightly lighter solid line. All easements must be shown, as well as the book and page number, if recorded.

2.1.8 Minimum Requirements. It shall be understood that the requirements outlined in these standards are minimum requirements and shall be applied when conditions, design criteria, and materials conform to the City specifications. When unusual subsoil or drainage conditions are encountered, an investigation should be made and a special design prepared in conformance with good engineering practice.

2.1.9 Owner's Name. The title sheet must indicate the owner's name and address for whom the improvements are to be constructed.

2.1.10 Dimensions. Lot lines, dimensions, and subdivision name shall be shown where applicable.

2.1.11 Cover Sheet. All plans shall have a cover sheet showing the general location of the project in relation to the Springfield City street system. The cover sheet shall show the complete project area to a scale of 1" = 100' or an appropriate scale for small projects.

2.2 PRE-CONSTRUCTION REQUIREMENTS

2.2.1 Fees. After plans have been approved and filed by the City, it is the Developer's responsibility to pay all necessary fees prior to construction.

2.2.2 Copy of Contract. A detailed copy of the construction bid, showing unit costs for all items included in the contract, and showing the total contract value, must accompany the fee.

2.2.3 Start of Construction. No construction of public facilities shall be permitted prior to approval and filing of the plans and/or paying of fees. In addition, 24-hour notification must be given to the Public Works Construction Office prior to the commencement of any work on

public facilities. No street construction will be permitted prior to completion of construction of all private and/or public utilities within the street right-of-way.

2.2.4 Easements. All easements required for construction, which are not included on the plat, shall be recorded and filed with the City prior to filing of original plan sheets.

3 SURVEYING WORK

3.1 Horizontal Control. Establish accurate horizontal control on the proposed work site. Physical monuments such as large nails, iron pins, or other durable materials must be set and accurate horizontal positions established on them. A positional tolerance error between any 2 points in the control network will not exceed 0.05'. A positional tolerance error between adjacent pairs of control monuments will not exceed 0.02'.

3.2 Vertical Control. Establish accurate vertical control on the proposed work site. The North American Vertical Datum of 1988 will be used, propagated from NGS or City of Springfield benchmarks. The Benchmark used to establish vertical control will be listed on the plans. Elevations will be established on the same monuments used for horizontal control as well as 2 temporary benchmarks located in areas where they will not be disturbed by construction. A vertical tolerance error between adjacent pairs of control monuments will not exceed 0.01'. Overall the error shall not exceed 0.05' in 5000'. Some form of differential leveling with a spirit level will be used; trigonometric leveling or GPS derived elevations are not acceptable for establishing elevations on control monuments.

3.3 Topography. Topography shall include all surface features within the limits of the project such as buildings, curbs, trees, water valves, walls, etc. This may also include painted markings for subsurface utilities as well as utilities that are exposed by excavation for more accurate locations. Sizes of pipes, culverts, and conduits shall be noted. Elevations and horizontal positions of critical topographic features such as flow lines of box culverts, flow lines of sewer manholes, curbs and other hard surfaces must be accurate to within 0.05' or better.

3.4 Contours. The vertical accuracy of contours shown on plans will be +/-0.5' for contour intervals of 1 foot or more. The vertical accuracy of contours of less than 1 foot intervals will be +/- one half (1/2) the contour interval.

3.5 Boundary and Right-of-Way. All work relating to property corners, boundary lines, right of way lines, and calculated property lines will be done under the direct supervision of a Professional Land Surveyor licensed in the state of Missouri. The land surveyor will use the current City of Springfield Subdivision Regulations for any boundary survey work related to design surveys.

4 EARTHWORK

4.1 EMBANKMENT CONSTRUCTION

All embankments required for construction of public streets and alleys must be compacted. The method of compaction and densities are as required in the latest revision of the City of Springfield Standard General Conditions and Technical Specifications for Public Works Construction. All embankment construction shall have a minimum 4:1 (H:V) forward and back slopes. All trees, shrubs, and plants designated to remain within the public right-of-way shall be shown and clearly noted on the plans. The plans shall require that the public right-of-way be left in a finished and neat appearing condition.

4.2 SUBGRADE COMPACTION

The plans shall require that the street subgrade for both public and private improvements be compacted as required in the latest revision of the City of Springfield Standard General Conditions and Technical Specifications. All street sub-grades shall have at least 4" of compacted aggregate (meeting Type 1, Type 5 or Type 7 Aggregate Base requirements) base. Aggregate should extend 1' - 0" outside the limits of the curb and gutter.

5 SANITARY SEWERS

5.1 GENERAL

5.1.1 Materials. All materials used in the construction of sanitary sewers shall conform to the latest revision of the City of Springfield Standard General Conditions and Technical Specifications for Public Works Construction unless specifically designated otherwise by special provision drawings and prior approval is obtained.

5.1.2 Discrepancies. Where discrepancies between standard details, drawings and/or special provisions occur, the special provisions shall govern.

5.1.3 Structures. Whenever possible, structures shall be constructed as shown in the standard details. Structures other than those shown in the standard details shall be considered to be special structures and must be designed and detailed by the design engineer.

5.1.4 Construction on Fill. Where a sewer must be constructed on fill, a profile of the original undisturbed ground line along sewer centerline shall be shown. All sewers to be constructed on fill must have a special design approved by the Public Works Department.

5.2 SANITARY SEWER DESIGN

5.2.1 Design Period. Sanitary sewer systems must be designed for the estimated ultimate tributary population. Consideration should be given to the maximum anticipated capacity of institutions and industries.

5.2.2 Design Factors. In determining the required capacities of sanitary sewers the following factors shall be considered:

A. Maximum hourly quantity of sewage.
B. Additional sewage volume or waste from industrial plants
C. Ground water infiltration.

5.2.3 Design Basis.

5.2.3.1 Per Capita Flow. Sewer systems shall be designed on the basis of the maximum hourly flow of three (3) times the average daily per capita flow of sewage. In no case shall the average daily per capita flow be considered less than one hundred (100) gallons per day. This figure is assumed to cover normal infiltration, but an additional allowance should be made where ground conditions are known to be unfavorable and industrial wastes are present.

5.2.3.2 Alternative Method. When deviations from the foregoing per capita rates are warranted, a brief description of the proposed procedure to be used for the sewer design shall be included.

The Department of Public Works recommends 2,500 to 3,000 GPD per acre for single-family gross area exclusive of sewage or other waste from industrial plants.

5.2.4 Design Details.

5.2.4.1 Minimum Size. No public sewer shall be less than eight inches in diameter.

5.2.4.2 Location. Sewers shall be placed in street right-of-way where feasible. Plans shall show the stationing of all in-line tees.

5.2.4.3 Depth. Sewers shall be designed deep enough to prevent freezing, and to allow house connections to cross under water mains at such an elevation that the bottom of the water main is at least eighteen (18) inches above the top of the sewer line. If the proposed sewer is parallel to a water main, it shall be designed to provide a minimum 18-inch vertical clearance or a minimum 10-foot horizontal clearance from the water main. Unless approved by the Director of Public Works, no sewer shall be designed and/or constructed that will not provide a minimum depth of four (4) feet to top of pipe. All PVC sewers over 12’ deep shall be SDR 21, Class 200 pipe. All sewers over 12’ deep shall have a minimum of 12” of aggregate bedding material over the top of the pipe.

5.2.4.4 Slope. All sewers shall be designed and constructed so as to give mean velocities, when flowing full, of not less than 2.0 feet per second, based on Mannings formula using an “n” value of 0.013.

5.2.4.5 Slope calculations and detailing. The slope on all sewer lines shall be calculated from inside wall of manhole to inside wall of manhole.

The following are the minimum slopes, which should be provided; however, slopes steeper than these are desirable.

Sewer Size	Minimum Slope in Feet per 100 Feet
8”	0.40
10”	0.28
12”	0.22
14”	0.17
15”	0.15
16”	0.14
18”	0.12
21”	0.10
24”	0.08

Sewers shall be laid with uniform slope between manholes. The maximum slope for all main line sewer pipes shall be 35%. The minimum slope for all laterals shall be 1/8 inch per foot, unless otherwise approved.

5.2.4.6 Loading. All sewers shall be designed to prevent damage from superimposed loads. Proper allowance for loads on the sewer shall be made because of the width and depth of trench.

5.2.4.7 Grade through Manholes. A drop of 0.2 feet shall be shown through manholes. The flow line of new sewer lines coming into a main sewer manhole should be at least one half the diameter of the trunk sewer above the flow line of the trunk sewer.

5.2.4.8 Increasing Size. When a smaller sewer joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient.

5.2.4.9 Alignment. Sewers in streets should be placed in or near the center of the driving lane where possible. Sewers located at back property lines should be about three feet to one side of the property line and on the opposite side from pole lines or other utilities. The ends of sewer lines should extend at least fifteen feet beyond the property line of the last lot served, to provide room for the house connection with a tee below the manhole. Cutting corners and running diagonally across streets is not allowed.

A minimum permanent easement of 7.5' either side of sewer is required. A temporary construction easement shall be provided, as necessary. All crossing and/or cutting of streets must be backfilled with granular material. All sewers with a trench wall within two feet of the back of the street curb shall be backfilled with granular material.

5.2.5 Relation to Water Mains or Storm Sewers.

5.2.5.1 Horizontal Separation. Wherever possible, sewers should be laid at least 10 feet, horizontally, from any existing water main or storm sewer. Should local conditions prevent a lateral separation of 10 feet, a sewer may be laid closer than 10 feet to a water main or storm sewer if:

A. It is laid in a separate trench, or
B. It is laid in the same trench with the water mains or storm sewer located at one side on a bench of undisturbed earth, and
C. In either case the elevation of the top (crown) of the sewer is at least 18" below the bottom (invert) of the water main or storm sewer.

5.2.5.2 Vertical Separation. Whenever sanitary sewers must cross under water mains or storm sewers, the sanitary sewer shall be laid at such an elevation that the top of the sanitary sewer is at least 18" below the bottom of the water main or storm sewer. When the elevation of the sanitary sewer cannot be varied to meet the above requirement, the water main or storm sewer shall be relocated to provide this separation.

When it is not feasible to obtain proper horizontal and vertical separation as stipulated above, the sewer must be constructed of SDR 21, Class 200 pressure water line pipe and must be air tested at a pressure not less than four (4) pounds per square inch for five (5) minutes to assure water tightness. A manhole must be located at each end of the pressure pipe; and the near side of the manholes can be no closer than ten (10) feet from the water main.

No water line shall pass through or come into contact with any part of a sanitary sewer manhole.

5.2.6 Manholes.

5.2.6.1 Location. Manholes shall be installed at all changes in grade, size or alignment, at all intersections, and at intervals of not more than 500 feet for sewers 15 inches in diameter or less, and 600 feet for sewers 18" and larger in diameter.

5.2.6.2 Drop Type. A drop pipe shall be provided for a sewer entering a manhole at an elevation of 24" or more above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches, the invert shall be filleted to prevent solids deposition; manholes, where the difference in elevation between the incoming sewer and the manhole invert is greater than 24 inches but less than 36 inches will not be allowed. Special design is required for connection to manholes with interior linings.

5.2.6.3 Diameter. The minimum diameter of manholes shall be 48 inches (4 feet), and shall conform to the latest revision of the City of Springfield Standard General Conditions and Technical Specifications. All inside drop manholes shall have a minimum diameter of 60 inches (5 feet).

5.2.6.4 Manhole Covers. All sanitary sewer manhole covers shall be Type "A," non-rocking, unless located within floodplain or prone to submersion. If located within floodplain or prone to submersion, use water-tight, hinged Pam-rex lid or EJ 24" ERGO no. EJ001040013L01 lid and frame or approved equal.

5.2.6.5 Stationing and Elevation. Stationing and elevations should be shown at all M.H. locations.

5.2.7 Lampholes. Lampholes may be permitted upon the approval of the Department of Public Works. Lampholes will be permitted only in cases where the slope of the land will not permit a future extension of the sewer beyond the proposed lamphole. The maximum length to the nearest manhole shall not be greater than 150 feet. Lampholes will not be permitted within street surfaces. Tees not to be located within 5' of the lamphole riser.

5.3 DRAWINGS AND DOCUMENTS TO BE SUBMITTED

5.3.1 Sewer Drawings. Sewer drawings shall be prepared on plans separate from other utilities. District, Section, and Public Works file numbers shall be obtained from the Department of Public Works.

5.3.1.1 Plan. The plan shall be at the top of the drawing. Standard symbols shall be used. A standard north arrow shall be located on each sheet (pointing up or to the right).

A. Scale shall be 1” = 40’ horizontal for undeveloped areas and 1” = 20’ for developed areas.
B. Method of Indicating Location. Sewers and manholes within streets and adjacent developed areas shall be located in plan by dimensions from property markers or other well-defined physical features.

5.3.1.2 Profile. The profile shall be shown under the plan.

A. Scale. Scale shall be 1” = 4’ vertical, and 1” = 40’ horizontal for undeveloped areas and 1” = 20’ for developed areas.
B. Grades. Established elevations of existing manholes shall be obtained from the Department of Public Works, and then verified in the field. When such grades are not available, they shall be established by the design engineer and submitted to the Department of Public Works for approval. Existing ground and proposed pavement over sewer shall be shown and labeled. Existing or proposed building floor elevations or sufficient ground elevation 100 feet either side of centerline shall be shown to determine required depth and slope of service lines.

5.3.1.3 Utilities. Existing and proposed utilities shall be accurately and clearly shown in plan and profile. Elevations of existing utilities shall be obtained where possibility of conflict exists.

5.3.1.4 Location and Design Information. A cover sheet shall be Sheet No. 1 of the drawings, indicating the entire area to be served by the proposed sewers and indicating the sheet number on which each segment of sewer line is drawn. The scale shall be 1” = 100’. When this cannot be done without attaching an extra drawing, then the scale will be 1” = 200’. Proposed district boundaries shall be shown with sufficient data that a written district boundary description may be described from it, and a written boundary shall be attached to the drawing. Also, all lots, blocks, and the location of proposed sewer lines shall be known. When the cover sheet will not show at least two well-known streets or routes, a small location map shall be added to the cover sheet showing the location of the project. Benchmarks based on USGS datum shall be shown on the drawings as per the Survey Requirements included as Chapter III of these Design Standards. The Department of Public Works will review the plans to determine its compatibility with the entire drainage area. The developer or owner’s name shall be shown on the cover sheet along with the subdivision name.

5.4 LIFT STATIONS

5.4.1 General. A sewage lift station shall consist of a wet well, sewage pumps, control systems, electrical systems (normal and emergency), superstructures, site security systems, grading, and access.

The purpose and goal of a lift station is to serve as a sewage collection point for a development and to pump that sewage to a gravity line serving the area in a safe, economical, and easily-maintained manner.

5.4.2 Buildings and Grounds.

5.4.2.1 Flooding. Sewage pumping stations shall not be subject to flooding due to storm water runoff. A suitable superstructure located off the right-of-way of streets and alleys shall be provided.

5.4.2.2 Fencing. A fence surrounding the station site shall be provided. The fence shall be eight (8) feet high (minimum) with a twelve (12)-foot wide, double-leaf gate. The fence shall be galvanized chain link except where subdivision rules require a wooden privacy fence. Supporting posts for all types of fences shall not be more than eight (8) feet apart and be concrete encased below grade. Minimum bury depth of posts to be two and one-half (2-½) feet. Wooden fences shall be constructed of pressure treated or other approved weather resistant wood. Wooden support posts shall be 4" x 4" minimum. The gate is to be located so that entranceway does not go over manholes. The pump station and generator unit is to be easily accessible for maintenance from entranceway. The gate is to be set back twenty-five (25) feet from edge of road.

5.4.2.3 Surfacing of Lift Station Area. The area inside the fence must be constructed of four (4) inches of Type 1 aggregate, compacted according to City Specifications, on a four (4) mil polyethylene sheeting placed over the entire enclosed area. This sheeting shall have one (1)-inch diameter perforations spaced not more than two feet in each direction. Prior to placing the sheeting, the soil to be covered is to be treated with a soil sterilant Diuron (Karmer by DuPont), or equal, and applied as directed by the manufacturer.

5.4.2.4 Accessibility to Site. The pump station must be accessible by an acceptable all-weather, hard-surface road meeting the same requirements as other roads in the development. Junction of pump station road and public street shall have a minimum sixteen (16)-foot-long culvert of acceptable diameter in ditch if necessary.

5.4.2.5 Outside Lighting. An outside weatherproof pole-mounted, high-intensity discharge lighting fixture of not less than 175 watts with an electrical eye with dusk-to-dawn operation shall be provided. The light is to be of the high-pressure sodium type with electric eye for dusk-to-dawn operation.

5.4.2.6 Switching Gear and Controls. Generator unit, switching gear, and controls to be mounted inside a weatherproof building with four (4) feet (minimum) clearance on each side of generator unit, with a minimum height of eight (8) feet. The building may be a wood frame, metal or masonry building mounted, and attached to a six-inch non-reinforced concrete floor.

5.4.3 Design. The following items should be given consideration in the design of sewage pumping stations:

5.4.3.1 Type. Sewage pumping stations may be either suction-lift type or submercible. When total suction lift exceeds fifteen (15) feet, only the submercible type will be permitted. When GPM from one pump is 700 GPM or greater, a dry well/wet well-type station would be acceptable.

5.4.3.2 Structures.

5.4.3.2.1 Separation. Wet and dry wells including their superstructure shall be completely separated.

5.4.3.2.2 Pump Removal. Provision shall be made to facilitate removing pumps and motors.

5.4.3.2.2.1 Submercible pump stations shall have a slide coupling and guide rails lifting system. A stainless steel lifting cable, with one end permanently attached to the pump-lifting lug and the other end secured at grade level, shall be provided.

5.4.3.2.2.2 Dry well/wet well stations shall have a hoist and trolley system to lift and move the pumps to the access opening.

5.4.3.2.2.3 Suction lift stations shall have lifting arm for removing motor and pump from base.

5.4.3.2.2.4 Where pump station is enclosed in a building, equipment shall be provided for moving pumps and motors to the access doorway.

5.4.3.2.2.4.1 Access. Suitable and safe means of access shall be provided to dry wells of pump stations and shall be provided to wet wells containing either bar screens or mechanical equipment requiring inspection and maintenance. Stairways or ladders exceeding fifteen (15) feet shall not rest landings at vertical intervals not exceeding ten (10) feet.

5.4.3.3 Pumps.

5.4.3.3.1 Duplicate Units. At least two (2) pumps shall be provided. If only two (2) units are provided, they must have the same capacity. Each shall be capable of handling flows in excess of the expected maximum flow. Where more than two (2) units are provided, each shall be designed to fit maximum flow conditions and must be of such capacity that with any one unit out of service the remaining units will have capacity to handle maximum sewage flows.

5.4.3.3.2 Protection Against Clogging. Where the size of the lift station is 700 g.p.m. or greater, a trash rack located below floor level shall be provided. Where screens are located below ground, facilities must be provided for handling screenings.

5.4.3.3.3 Pump Openings. Pumps shall be capable of passing spheres of at least three (3) inches in diameter. Pump suction and discharge openings shall be at least four (4) inches in diameter.

5.4.3.3.4 Priming. The pump shall be so placed that under normal operating conditions it will operate under a positive suction head, except as specified for suction-lift pump stations. Each suction-lift pump shall have a priming system independent from other pumps.

5.4.3.3.5 Intake. Each pump shall have an individual intake. Wet well design shall be such as to avoid turbulence near the intake.

5.4.3.3.6 Dry Well Dewatering. A separate sump pump shall be provided in the dry wells to remove leakage or drainage with the discharge above the overflow level of the wet well. Water ejectors connected to a potable water supply will not be approved. All floor and walkways surfaces shall have an adequate slope to a point of drainage.

5.4.3.3.7 Submercible Pump Seals. Tandem mechanical seals are required on submercible pumps.

5.4.3.4 Valves. A shut-off valve shall be placed on suction and discharge lines of each pump. A check valve with external arm shall be placed on each discharge line between the shut-off valve and the pump. An external arm check valve is required with a lever-operated micro switch for telemetering purposes. These valves shall be located outside of the wet well and shall be readily accessible for repairs.

5.4.3.5 Wet Wells.

5.4.3.5.1 Grit. Where it may be necessary to pump sewage prior to grit removal, the design of the wet well should receive special attention and the discharge piping shall be designed to prevent grit settling in pump discharge lines of pumps not operating.

5.4.3.5.2 Divided Wells. Where continuity of pumping station operation is required, consideration shall be given to dividing the wet well into two sections, properly interconnected, to facilitate repairs and cleaning.

5.4.3.5.3 Floor Slope. The wet well floor shall have a minimum slope of one (1) to one (1) to the hopper bottom.

5.4.3.6 Ventilation. Adequate ventilation shall be provided for all pump stations. Where the pump pit is below grade, mechanical ventilation is required. In dry well/wet well stations, mechanical ventilation is required when screens or other mechanical equipment requiring maintenance or inspection is located in the wet well. There shall be no interconnection between the wet well and dry well ventilation systems. In pits over fifteen (15) feet deep, multiple inlets and outlets are required. Dampers shall not be used on exhaust or fresh air ducts, and fine screens or other obstructions in air ducts shall be avoided to prevent clogging. Switches for operation of ventilation equipment shall be marked and located at grade level. Ventilation equipment and lighting shall be energized when lid is open on dry well type stations. The fan wheel shall be fabricated from non-sparking material. Automatic heating and dehumidification equipment is required when station is located below grade level.

5.4.3.6.1 Wet Wells. Ventilation may be either continuous or intermittent. Ventilation, if continuous, shall provide at least twelve (12) complete air changes per hour; if intermittent, at least thirty (30) complete air changes per hour. Such ventilation shall be accomplished by introduction of fresh air into the wet well by mechanical means.

5.4.3.6.2 Dry Wells. Ventilation may be either continuous or intermittent. Ventilation, if continuous, shall provide at least six (6) complete air changes per hour; if intermittent, at least thirty (30) complete air changes per hour.

5.4.3.7 Water Supply. Potable water shall be supplied; however, there shall be no physical connection between the potable water supply and a sewage pumping station. Potable water supply line shall not be smaller than one-half (1/2) inch. A freeze-proof hydrant with hose bib shall be located within ten (10) feet of pumping station but not in the traffic path.

5.4.3.8 Dry Well Covers and Lids. Covers shall be made of lightweight, weather-resistant material and constructed so that it may be easily opened by one person. If force required to open cover is in excess of fifty (50) pounds, shock absorbers or opening springs must be provided.

5.4.3.9 Spare Parts. Pump stations are to be provided with two (2) mechanical seals and two (2) gasket kits to install with seals. If seal filters are used, six (6) spares are to be included. Two (2) complete sets of contacts and coils for starters and one (1) spare alternator relay or timer shall also be furnished.

5.4.3.10 Force Main Interface. A force main interface consisting of piping, a 45-degree "Y," 45-degree elbow, and flanged, full-flow valve shall be provided.

A. All pipe and fittings shall be the same material and the same size as the force main.

B. The interface shall be constructed within a four-foot manhole of required depth located external from but adjacent to the pump station.

C. A standard manhole frame and cover shall be installed flush with finished grade.

5.4.3.11 Special Requirements for Suction-Lift Pump Stations. In addition to the previously mentioned requirements for suction-lift stations, the following shall apply:

5.4.3.11.1 Priming. Suction-lift pumps shall have a reliable record of satisfactory operation and be installed with a single piece suction line braced to the side of wet well. Priming shall be by dual vacuum systems independent of each other.

5.4.3.11 .2 Capacity. Approval will be restricted to installations where total suction-lift does not exceed fifteen (15) feet.

5.4.3.12 General Electrical Requirements. All electrical equipment and wiring shall comply with the latest revision of the National Electrical Code. Particular attention should be given to electrical equipment enclosed in places where gas may accumulate (hazardous areas). Submercible pumps are considered to be in a hazardous area and shall be rated explosion proof by Underwriters Laboratory. This rating shall include pumps, removal systems, and controls. Vacuum primed pump controls systems must be operated through intrinsically safe relays for hazardous locations. All conduit shall be of galvanized rigid type and shall be installed below

grade wherever possible. Dry-type transformers for 110-Volt utility service and control systems power shall be provided.

5.4.3.12.1 Primary power to the station shall be no higher than 480 Volt, 3 Phase, and shall be provided by connection to a commercial utility service. A single disconnect is to be provided between the pump station and the utility.

5.4.3.12.2 Emergency Operation. Provision of an emergency power supply for pumping stations shall be made, and may be accomplished by connection of the station to a second independent public utility source or by provision of in-place engine generator.

5.4.3.13 Controls. Control of pumps shall be by floating mercoid switches, normally open type. Minimum of four (4) switches shall be provided. The switches shall be used to indicate "PUMPS OFF," "FIRST PUMP ON," "SECOND PUMP ON," "HIGH LEVEL ALARM." The control panel shall include automatic pump alternation to equalize operating time on all duplex components. Elapsed time meters to be calibrated in one-tenth (0.1) hour increments on all pumps. Provisions shall be made to bypass the alternator in the event that either pump is out of service for maintenance. Motor starter coils to be rated 100 Volts, 50 Hertz. On larger lift station installations other control systems may be required. Hand-off-auto switch and elapsed time meters to be visible and operable through control panel door.

5.4.3.14 Alarm Systems. Alarm systems shall be provided for all pumping stations. Equipment shall be a microprocessor base with synthesized speech and design to operate on a single-party, pulse-dial telephone circuit. All necessary equipment shall be provided to transmit the following alarms: 1. High wet well liquid level; 2. Power failure; 3. Transfer to emergency power source; 4. Generator failure; 5. Pump No. 1 running; 5. Pump No. 2 running. Other alarm features may be required based upon pump station design.

5.4.3.15 Power Generating Equipment.

5.4.3.15.1 General. The power module shall consist of an engine, generator, and control panel assembly, all mounted with antivibration mounts onto a fabricated steel skid base. An automatic transfer switch may be mounted separately or in the control panel assembly to automatically switch to emergency power in the event of commercial power failure. The engine generator shall be sized for starting one (1) pump and all auxiliary loads, with an additional 50% overload capacity. The complete power module shall be factory assembled and factory tested to ensure that all controls and protective devices are in proper working order. The motor starting capability shall be tested by a simulation of the exact operating load, with certified test results provided. The power module must be coordinated with the pump station.

5.4.3.15.2 Engine. The engine shall be multi-cylinder, 4-cycle, and water-cooled. Water-cooled engines shall be provided with mounted radiator, fan and water pump with anti-freeze added to the cooling system to bring it to 20 degrees F. below zero protection. The fuel system shall consist of a carburetor with an automatic choke and an electric shutdown solenoid, and a dry-type air cleaner. The engine shall run on any reputable commercially available natural gas with minimum low-heat value of 950 BTU/cubic foot. The governor shall be capable of 3-5% speed

regulation from no load to rated load. The lubrication system shall be force fed by gear oil, pumped to all connecting rods, main bearings, and rocker arms. Oil filter shall be spin-on, full-flow type. Engine may be operated continuously when tipped up to 15 degrees in any direction. The engine starting system shall consist of a 12-volt battery and a 12-volt Bendix-type drive, solenoid-equipped electric starter. The charge on the battery shall be maintained by a 32-amp or larger charging alternator. A water-cooled engine shall be equipped with a jacket water heater to aid in starting and engine longevity.

5.4.3.15.3 Alternator. The alternator shall be a full 3-phase, 4-pole, self-excited, brushless, revolving field type with static exciter. It shall be self-regulated and designed specifically for motor starting application. The alternator shall be directly connected to the engine flywheel housing and driven through a semi-flexible driving flange to ensure permanent alignment. It shall have drip-proof construction. Voltage regulation shall be within plus or minus 5% of rated voltage from no load to full load. Insulation shall be Class F with a 70 degree C maximum temperature rise. A completely wired and assembled generator control panel shall be furnished. It shall contain the following items: 1. One ammeter with phase selection switch; 2. One voltmeter with phase selection switch; 3. One vibrating-vane type frequency meter; and 4. Integral battery charger 0-10 amp. 6. A line circuit breaker for alternator output leads.

5.4.3.15.4 Automatic Transfer Switch. The automatic transfer switch shall be a mechanically-held, double throw. The transfer action must be completely electrical and not rely on springs or counterweights. Operating coils must be momentarily energized from the source to which the load is being transferred. The switch must be interlocked both mechanically and electrically to prevent both sources from feeding the load at the same time. Electrical operation must not allow a neutral position. The main contacts of the transfer switch shall meet with a rolling and wiping action. They shall be copper with cadmium plating up to and including 100 amps and silver plating on all sizes above 100 amps. They shall be rated for all classes of load to 480 volt AC and equipped with blowout coils and arc chutes. They shall have air inrush current rating of 20 times rated current and an interrupting capacity of 1.5 times rated current. The transfer switch shall include auxiliary contacts to provide for the locking out of the standby pump and connection to alarm system. It shall also have three voltage-sensitive relays with dropout 70-80% adjustable pickup at 90%. Upon sensing of under-voltage condition, the generator startup and transfer sequence shall be initialed automatically. Provision shall also be made to manually initiate the sequence.

5.4.3.15.5 Engine Control Panel. The engine control panel is to include five (5) ten-second-on/10-second-off cranking cycles, a switch for testing the automatic operation, a switch for deactivating the automatic operation, an oil pressure gauge, coolant temperature gauge, battery charging DC ammeter, elapsed time meter, indicating lights for fail-to-start, line-power-on, and standby-power-on, protective shut-down, with indicating lights for engine overspeed, low oil pressure, overload, high coolant temperature, manual start-run-stop switch, 0-60-second time delay on transfer Normal to Emergency, 0-30-minute time delay on transfer Emergency to Normal, 0-5-minute time delay after transfer to normal for engine cool down, contacts to signal emergency power on, contact to signal fail-to-start, contact to signal protective shut-down and fail-to-start, and a weekly exercise timer.

5.4.3.15.6 Placement. The unit shall be bolted in place. Facilities shall be provided for unit removal for purposes of major repair or routine maintenance.

5.4.3.15.7 Engine Location. The unit internal combustion engine shall be located above grade with exhaust muffler and outlet located outside of housing. The muffler system shall be residential type or better. Exhaust sleeve from building to be approved by National Fire Protection Association Code.

5.4.3.15.8 Engine Cooling Ventilation. Cooling air shall be provided by venting from the outside to the engine. The vent shall be properly located and sized to assure an adequate air supply. Vents to have screen on inside to prevent bugs and birds from entering.

Engine housing shall have adequate ventilation to maintain a safe equipment operating temperature.

5.4.3.15.9 Emergency Power Generation. All emergency power generation equipment shall be provided with instructions indicating the essentiality of routinely and regularly starting and running each unit at full load.

5.4.3.15.10 Generator Spare Parts. Generator spare parts are to include one (1) spare circuit board of each type used, or provide a means for bypassing and testing circuits.

5.4.4 Acceptance of Lift Station.

5.4.4.1 Shop Drawings. Shop drawings shall be submitted on lift station, stand-by power source and structures, and be approved prior to installation. Three (3) copies are required.

5.4.4.2 Testing. Prior to acceptance of lift stations by the City, testing of each equipment item shall be required in the presence of the Contractor, a City representative, and the equipment manufacturer's representative. Final acceptance will not be made until all deficiencies are corrected and retesting is performed.

5.4.4.3 As-Builts. Prior to acceptance of operation of lift station, generator units, and other related appurtenances by the City, one (1) set of mylar reproductibles and three (3) sets of prints of "As-Builts" shall be submitted.

5.4.4.4 Operation and Maintenance Manuals. Four (4) complete sets of operational instructions shall be provided to include emergency procedures, maintenance schedules, maintenance manuals, and service manuals on all equipment. Special tools and such spare parts as may be necessary shall be furnished to the City for the facilities to be accepted.

5.5 FORCE MAINS

5.5.1 Velocity. At design average flow, a cleansing velocity of at least four (4) feet per second shall be maintained.

5.5.2 Air Release Valve. An APCO Sewage Air Release Valve Model 401, or approved equal, shall be placed at high points in the force main to prevent air locking. A standard four-foot diameter manhole with standard frame and cover to be installed around force main and relief valve for maintenance access to valve.

5.5.3 Connection to Gravity System. The force main shall connect to the gravity sewer system at a point not more than two (2) feet above the flow line of the receiving manhole.

5.5.4 Design Pressure. The force main pipe and fittings shall be designed to withstand normal pressure and pressure surges.

5.5.5 Thrust Blocks. Concrete thrust blocking shall be provided at all bends 22 ½ degrees or greater.

5.5.6 Force Main Pipe. All force main pipe shall be P.V.C. AWWA C-900; however, SDR-21, Class 200 pipe will be required unless calculations are provided to verify that a lesser class of pipe is adequate. Pipe types less than Class 200 must be shown on the plans.

5.5.7 Depth. Force main pipe shall be designed and so constructed to provide a minimum depth of three (3) feet of cover over the top of the pipe.

5.5.8 Casing. Force mains designed to cross public streets must be encased with either reinforced concrete pipe or steel casing of adequate size to allow for future removal of the force main pipe.

5.5.9 Testing. Testing of the force main is required in accordance with the requirements of AWWA C-600. Testing pressure shall be: Total Design Head x 0.433 x 1.5. (Note: This must be shown on the plans.)

6 STORM SEWER AND DRAINAGE DESIGN

For Chapter 6 Storm Sewer and Drainage Design standards please reference the Flood Prevention and Water Quality Manual at the following link:

http://www.springfieldmo.gov/2120/Developer-Resources

7 STORMWATER DETENTION REQUIREMENTS FOR PUBLIC AND PRIVATE IMPROVEMENTS

For Chapter 7 Stormwater Detention Requirements for Public and Private Improvements standards please reference the Flood Prevention and Water Quality Manual at the following link:

http://www.springfieldmo.gov/2120/Developer-Resources

8 STREETS, ALLEYS, CUL-DE-SACS AND INTERSECTIONS

8.1. STREETS

8.1.1 Street Construction. City streets shall be constructed of Portland Cement Concrete with integral curb (or concrete curb and gutter) or bituminous plant mix roadway with a concrete curb and gutter. Alley pavement shall be of either asphalt or concrete design, with an inverted crown and the curb omitted. Asphaltic streets will require bituminous or "full depth" asphalt base.

8.1.2 Roadway Sections. Typical roadway sections showing various widths of roadway and right-of-way and required thickness are as shown on Standard Drawing ST-1 included in these design standards. Expressways should be designed according to MoDOT Standards.

8.1.3 Street Design. In the preparation of street design, the following criteria must be observed. These controls are intended to be the absolute minimum (or maximum) permitted. Any design not meeting this requirement must have prior approval. Road classification greater than those listed should be designed according to MoDOT standards.

8.1.3.1 Grades.
Minimum 0.5% All Systems
Maximum Arterial 5%
Maximum Collector 8%
Maximum (Residential and Non Residential) Local 10%
Maximum (Residential and Non Residential) Alleys 10%

8.1.3.2 Vertical Curves. The length of vertical curves shall be no less than that determined by the formula:

L = KA, where:
L = Length of vertical curve
A = Algebraic difference in grades
K = Determined by following table:

Table of "K" Values	Crest	Sag
- Arterial	80	70
Collector	60	60
Local Non-Residential	30	40
Local Residential	20	30
Alleys	10	20

8.1.3.3 Centerline Radii and Superelevation.
Minimum centerline radii (R) and Maximum super elevation (E)
- Arterial……. R = 600' E = 0.04

Collector…… R = 400’ E = 0.03
Local Non-Residential……... R = 300’ E = 0.02
Local Residential……... R = 175’ E = 0.02
Alleys……. R = 175’ Inverted 6” Crown

*Minimum length of super elevation runout = 100’

8.1.3.4 Minimum Curb Radii at Intersections:

	Intersecting Residential Local	Street Non-Residential Local and Collector
- Arterial	30'	50'
Collector	20'	30'
Local Residential	15'	20'
Local Non-Residential	20'	30'

8.1.3.5 Minimum Safe Stopping Sight Distance:
- Arterial……. 325’
Collector …. 250’
Local Non-Residential…….. 200’
Local Residential……... 150’

8.1.3.6 Minimum Safe Stopping Distance at Intersections:
Arterial……. 500’
Collector …. 450’
Local Non-Residential…….. 300’
Local Residential……... 250’

8.1.3.7 Intersections. All curb returns shall be designed with a wheel chair ramp meeting the requirements of Standard Drawings ST-10 or ST-11 included in these design standards. No drainage structures shall be allowed in the wheelchair path. Intersections shall be approached on all sides by leveling areas. Where the approach grade for either or both streets exceed 3 percent, the leveling area shall be a minimum length of 100 feet measured from the intersection of the edge of gutter flag or edge of road, within which no grade shall exceed a maximum of 3 percent with a maximum crossfall of 6” at the throat of the radius returns of the intersecting street. Right angle intersections shall be used whenever practicable. When local streets intersect collector or arterial streets, the angle of intersection of the street centerlines shall not be less than 75° A diagonal sight distance easement must be provided (as shown on sheets 8-5 and 8-6) on the property lines substantially parallel to the chord of the curb radius.

Elevations at street intersections shall be computed by extending curb grades to the P.I. of the intersection of curbs. A minimum of 0.3 feet fall around a curb return is required. Elevations around the curb return and centerline stationing at all radius points shall be shown on the plan.
8.1.3.8 Plan. The following information shall be shown on the plan portion of each plan sheet:

- Width of right-of-way.

- Width of pavement (back-to- back of curbs).
- Curb and right of way radii with elevation and stationing.
- Location and size of existing utilities, meters, valves, poles, street markers, signs, traffic signals, trees, shrubs, drainage ditches, structures, storm sewers, easements, sanitary sewers and manholes. The proposed location of any of the above must also be shown. Central angle, centerline radius, arc length, and tangent distance of horizontal curves. Stationing of beginning and end of paving, PC and PT stationing of curves..

8.1.3.9 Profile. The following information shall be shown on the profile portion of each plan sheet:

- Existing ground lines at the centerline with elevations shown at 50' intervals.
- Proposed grade at the centerline.
- Proposed top of curb elevation and stationing at areas where typical cross sections are not applicable.
- Centerline elevations and stationing at beginning and end of paving, beginning, end, and P.I. of vertical curves, and mid-ordinate of vertical curves.
- Elevation and station of low point of sags.
- Top of curb shall be noted.

8.1.3.10 Typical Section. A typical section shall be shown on the first plan sheet indicating:

- Pavement type, width, and thickness
- Crown
- Curbs
- Parkway Width and Cross Slope
- Right of way width
- Sidewalks

8.1.3.11 Cul-de-sacs. Information needed on cul-de-sacs is shown on Standard Drawing ST-5, included in these design standards.

8.1.3.12 Expansion Joints. Expansion joints in concrete paving shall be placed as shown on standard drawings at intersections unless otherwise shown on plans and at all structures crossing the roadway such as bridges, box culverts, etc. Expansion joints are required around junction boxes, inlets, etc.

8.1.3.13 Contraction Joints. Contraction joints in concrete paving shall be placed as shown on standard drawings at intervals of not more than 20 feet and not more than 20 feet from any expansion joint. Contraction joints shall be without dowels unless otherwise specified on plans.

8.1.3.14 Longitudinal Joints. Longitudinal joints shall be placed as shown on the Standard Drawings included in these design standards.

8.1.3.15 Manholes. Manhole designation and elevation of top of manhole must be given when located within right-of-way.

8.1.3.16 Storm Sewers. Flow line elevations must be given for storm sewers within right-of-way.

8.1.3.17 Approaches to existing streets. All approaches to existing curb and gutter streets shall be Portland Cement Concrete to the Right-of-Way.

STREET RIGHT-OF-WAY AND CONSTRUCTION REQUIREMENTS

	Expressway	Primary Arterial	Secondary Arterial	Collector	Non-Res. Local	Res. Local	Marginal Access
Right of way – Normal (Feet) at Intersection	130’	100’	70’	60’	60’	50’	40’ & 10E’
	---	---	80’	65’	---	---	---
Pavement Width – Normal (Feet) at Intersection	76’	69’	43’	37’	37’	27’	21’
	101’	81’	55’	43’*	---	---	---
Sidewalk Requirements**	As Needed	Both Sides	Both Sides	Both Sides	One Side	One Side	One Side
Minimum Centerline Radius	To Be Designed	To Be Designed	600’	400’	300’	175’	175’
Parking Prohibitions	Both Sides	Both Sides	Both Sides	Both Sides	Both Sides	As Needed	One Side

* Widening flared to the leaving side of opposite approaches
** Except in certain zoning districts, see Subdivision Regulations

RIGHT-OF-WAY TRIANGLE REQUIREMENTS

Intersection of / With	Expressway	Primary Arterial	Secondary Arterial	Collector		Non-Residential Local	Residential Local	Marginal Access
Expressway	A	A	A	B		B	B	B
Primary Arterial	A	A	A	B		B	C	C
Secondary Arterial	A	A	B	B		C	D	D
Collector	B	B	B	C		C	D	D
Non-Res. Local	B	B	C	C		C	D	E
Residential	B	C	D	D		D	E	E
Marginal Access	B	C	D	D		E	E	E

KEY:

A – 100’ X 100’ ROW triangle w/separate right turn lanes
B – 30’ X 30’ ROW triangle w/50’ corner radii
C – 10’ X 10’ ROW triangle w/30’ corner radii (or 15’ ROW radius)
D – 10’ X 10’ ROW triangle w/20’ corner radii (or 15’ ROW radius)
E – No ROW triangle w/15’ corner radii

9 TRAFFIC IMPACT STUDY GUIDELINES

9.1 GENERAL

A Traffic Impact Study (TIS) is required when a change in zoning generates more than one hundred (100) trip ends during the highest peak hour of the generator or more than one thousand (1,000) daily trip ends based on the values shown in Table 1. The Director of Public Works may require a TIS for any project when the change in number of trips exceeds 50 for any peak hour, or 500 for the day and the City Traffic Engineer has determined that the adjacent street meets any of the following conditions:

- Does not meet design for its classification,
- Has an existing traffic volume with a level of service of D or lower,
- Has identified safety deficiencies or concerns, or
- Has other identified conditions requiring improvements.

The thresholds apply to "raw" trip end volumes prior to any deduction for internal capture rates and/or pass-by trips. The City Traffic Engineer may determine the need for a Traffic Impact Study at the time of a Zoning Inquiry.

The TIS must be prepared by a professional engineer registered in the State of Missouri, hereinafter called "ENGINEER", able to demonstrate experience with traffic impact analysis. The level of analysis required may vary from simply providing the trip generation numbers for the proposed intensity of uses to analyses of impact on the adjacent roadway system and existing traffic controls with determination of improvements required to accommodate the increase in traffic due to the proposed development.

9.1.1 Traffic Impact Study: The scope of the Traffic Impact Study (TIS) is dependent on several variables including vehicle trips generated, existing street network (consistency with design standard, traffic volumes, and other conditions), location of the project site, proposed access points, and functional classification of street facilities. It is recommended that these criteria be discussed with the Traffic Operations Division prior to beginning work on a TIS to determine the scope of study and any other special considerations that will apply. A list of assumptions used in the analyses shall be included in the text describing the procedures used with the TIS.

- The study area to be included in a TIS is the area in which the development-generated traffic is found to have a significant impact on the surrounding street network and intersections. (The TIS guidelines provide an explanation of the method to determine the study area.)

A TIS report shall contain the following information:

- Size of the proposed development (acres, dwelling units, floor area, etc.),

- Trip generation rate and source for both daily and peak hour trips,
- Total trips generated (daily and peak hour),
- Directional distribution of trips to the existing street system,
- Trip assignment to the surrounding roadways,
- Level of Service (LOS) analysis for the development entrances to the adjacent streets using the procedures for intersections in the latest edition of the *Highway Capacity Manual*, published by the Federal Highway Administration,
- Level of service analysis for all intersections in the study area currently signalized or on the major thoroughfare plan using the procedures for intersections in the *Highway Capacity Manual*,
- Level of service analysis for all street segments in the study area using the procedures for roadway segments in the *Highway Capacity Manual*, and
- Required improvements to maintain the "standard level of service".

The requirements and method for analysis for a TIS is contained in *Transportation Impact Analysis for Site Development* **(2)**. This guideline highlights the general requirements and provides additional specific information in some areas.

The Traffic Impact Study report shall be formatted to include the following items:

- Title Sheet
- An Executive Summary two to eight pages in length describing key points of the study that can stand alone in the case report to Planning and Zoning Commission and City Council
- Table of Contents
- Introduction
- Location / Vicinity and Site Maps
- Analysis
- Conclusion and recommendations
- Appendices

9.2 METHODOLOGY MEETING

The applicant is encouraged to contact the City Traffic Engineer or his representative to review study methodology. The following information will be required for the methodology meeting, if such a meeting is requested either by the engineer or staff:

- Land use proposal
- Horizon criteria (Year(s) of site development build-out for each phase)
- Trip generation methodology
- Non-site traffic assumptions:
    - Existing traffic volumes
    - Identification of committed developments
    - Growth factors

    - Computer modeling assumptions
- Assumed trip directional distribution for traffic attracted to and from the proposed development

9.3 CONTEXT

9.3.1 Extent of Study

The study area for a TIS is defined as the area of influence in which the development-generated traffic is found to have a significant impact on the surrounding street network and intersections. The size of the area varies with several site-specific conditions, including:

- Size of the proposed development,
- Land uses of the proposed development, and
- Prevailing conditions on the existing street system.

The area for study shall include all street segments that have a two-way volume greater than 2,000 vehicles per day or are on the Major Thoroughfare Plan that will be impacted by 100 or more peak hour site-generated trips. Intersection analysis will be required for all signalized intersections and for intersections of all cross streets that have a two-way volume greater than 2,000 vehicles per day or are on the Major Thoroughfare Plan within the designated study area.

9.3.2 Study Horizon

The study horizon should be the anticipated opening year with full build-out and occupancy. For developments with more than one major phase, a separate horizon year should be provided for full build-out and occupancy of each major phase. The horizon is generally dependent upon the size of development and the length of time for construction and occupancy of the development project. A rule of thumb for the minimum horizon is two years from time of study for each 500 peak hour trips. Table 2 shows land use thresholds based on number of trips generated. Proposed major transportation system changes and planned significant regional land use changes also affect the selection of the study horizon or require the use of more than one horizon for the project.

9.3.3 Time Periods for Study

Trip end calculations shall include Average Daily Traffic (ADT) and Peak Hour Traffic (PHT) for a typical weekday. Weekends should be included if applicable (recreation uses, event and assembly uses, and certain retail uses). Morning peak hour is defined as the highest one-hour period between 7:00 and 9:00 a.m. and the evening peak hour period is defined as the highest volume of traffic in a one-hour period between 4:00 and 6:00 p.m. If the peak hour of the generator occurs at a different time period and is significantly higher than the volume at the peak hour periods on surrounding streets, analysis of the generator peak hour may be required. Trip end calculations and level of service analysis are to be provided for both AM and PM peak hours except retail commercial uses with less than 150,000 SF gross floor area or 500 PM peak hour trips and other uses that do not affect the normal AM peak hour of travel. When it is determined

that AM peak hour analysis is not required, a mid-day (highest volume of traffic during one hour between 11:00 a.m. and 1:00 p.m.) analysis may be required. If the peak hour of the generator is on a weekend or at another weekday time period, an analysis of the time of that peak hour may be required.

9.3.4 Modal Split

The modal split for a TIS should be assumed to be 100% automobile except in specific circumstances. The developer or his representative may discuss an appropriate modal split when (1) the site is in center city, (2) the development is expected to be heavily influenced by non-automobile modes, and/or (3) incentives for encouraging non-automobile modes are provided.

9.4 TRIP GENERATION

The trip ends to be generated by the development may be estimated using the attached table for trip generation by acre for each zoning classification. Where specific uses and development density are known, trip ends shall be estimated using the current edition of *Trip Generation*. Trip generation rates derived from observation of similar developments may also be used as approved by staff. Where development density is greater than that used to estimate the trip generation rates in Table 1, trip ends shall be estimated using *Trip Generation*. The method used to generate trips, whether to use average rates or a linear regression equation, and how to use rates determined by similar studies must be discussed with Traffic Engineering staff prior to beginning the TIS.

The *Trip Generation Handbook* **(3)** provides discussion on pass by trips and diverted link trips. The applicant can request to reduce the impact on adjacent roadway by using the pass by and diverted link trip tables contained in the *Trip Generation Handbook*. The number of trips entering and leaving the site is not affected by the use of pass by or diverted link trips. The City Traffic Engineer must approve the rate of reduction or diversion being used prior to beginning detailed level of service analysis.

Internal capture trips can be estimated when the development includes a mix of uses using the procedures set up in the *Trip Generation Handbook.* Trip rates for the Shopping Center, Office Park, Business Park, or other aggregate category usually appropriately reflect a proposed mix of commercial uses. Internal capture trip estimates are appropriate for a mix of commercial and residential uses in a development and for circumstances when the mix of uses is not reflected in one of the aggregate use categories. The City Traffic Engineer must approve the rates being used prior to beginning detailed level of service analysis.

9.5 EXISTING AND HORIZON NON-SITE TRAFFIC CONDITIONS

It will be necessary for the engineer to obtain existing traffic data for all the locations identified in the study area for applicable peak hour volumes. The City of Springfield maintains an extensive database of traffic volume data that can be used when applicable. Where data is not

available in the Springfield data base, peak hour counts or other approved data may be used. Traffic count data can be adjusted to determine baseline traffic volumes along a corridor.

Existing traffic counts shall include turning movement counts in 15-minute increments during the appropriate peak hours at all intersections within the identified study area and at the development entrance (if existing). Hourly segment volumes for a minimum of 24 hours between noon Monday and noon Friday on all roadway segments identified for study must be used if available and, if not available, may be required for segments where the proposed development will exert a substantial impact. If any segment volumes are estimated from peak hour counts, the report must state that the volumes are estimated and describe the method of estimation.

Identify whether raw counts are used, or whether counts are adjusted for axle count or seasonal variations.

Traffic volumes must be projected to the horizon year using a method acceptable to the City Traffic Engineer. Expansion of baseline volumes using an expansion factor derived from historic volume trends is the most common method of determining horizon year non-site traffic volumes. Data available for other known development projects or land uses in the study area may be required when determining non-site horizon year traffic volumes. Use of the regional travel model may be appropriate for some large developments.

9.6 TRIP DISTRIBUTION AND ASSIGNMENT

The specific limits of the area of influence are based on information obtained from a review of both the Trip Generation and Existing Traffic Conditions. Trip distribution should be based on location of projected population or employment relative to the proposed development or retail marketing data at project build-out within the area of influence. Trip assignment should be based on shortest travel time between trip origin and destination. Since this portion of the TIS is somewhat subjective, it is important that the applicant discuss trip directional distribution with the Traffic Engineering staff to achieve consensus before beginning capacity and level of service calculations. Failure to discuss this important aspect of the TIS with the Traffic Engineering staff could require reevaluation of the traffic assignments and reassessment of impacts.

9.7 CAPACITY AND LEVEL OF SERVICE ANALYSIS

Capacity and Level of Service (LOS) calculations for intersections and street segments for existing traffic, horizon non-site traffic, and horizon traffic with development shall be made using the procedures outlined in the Highway Capacity Manual **(4)**. Complete LOS analyses are to be provided for the time periods previously described

9.8 REQUIRED IMPROVEMENTS (FOR STANDARD LEVEL OF SERVICE)

Existing LOS shall be defined as LOS "C" when the existing conditions are LOS "C" or better and as existing LOS when existing conditions are LOS "D" or poorer. For signalized intersections, existing LOS is assumed to be met if the calculated delay per vehicle for any movement is not increased by more than ten (10) seconds and the calculated delay per vehicle for the intersection is not increased by more than two (2) seconds. The Engineer must determine what street improvements are required to maintain the existing LOS and provide LOS analysis showing that the "standard" LOS is maintained by making the recommended improvements. The recommendations must be submitted as a part of the TIS to be reviewed and approved by staff. If the improvements are not found to be adequate, the staff is likely to recommend against the development proposal. It is suggested that TIS be amended with lower development intensity and resubmitted to obtain staff consensus prior to public hearings.

9.9 REFERENCES

(1) Institute of Transportation Engineers. *Trip Generation, 9th Edition*, Washington, D.C.: ITE, 2012
(2) Institute of Transportation Engineers. *Transportation Impact Analysis For Site Development, An ITE Proposed Recommended Practice*, Washington, D.C.: ITE, 2005.
(3) Institute of Transportation Engineers, *Trip Generation Handbook, 2nd Edition, An ITE Recommended Practice*, Washington, D.C.: ITE, 2004
(4) Transportation Research Board. *Highway Capacity Manual*, Special Report 209. Washington, D.C.: TRB, 2000

Copies of these references are available at the office of the City Traffic Engineer for review. Each of these publications may be purchased through the ITE Bookstore at www.ite.org/bookstore/index.asp.

9.10 DATA PRESENTATION

The following information is a listing of the minimum format items for a Traffic Impact Study report:

- Title Sheet that contains:
  - Title of Report (Traffic Impact Study for . . .)
  - Name of Project (Including name of subdivision, street address of site, nearest street intersection to the site, or other identifying feature)
  - Space for Development Case Number to be Added by Staff
  - Name of Applicant
  - Date of Report
  - Name and Address of Traffic Consultant, and

    - Seal and signature of a Professional Engineer registered in the State of Missouri under whose supervision the report was prepared.
- An Executive Summary suitable for presentation to Planning Commission and City Council as a stand-alone document two to eight pages in length describing key points of the study including:
    - Summary of the project
    - Table or exhibit showing following for ADT and peak hour:
        - Existing trip generation and traffic volumes (ADT and Peak)
        - Future trip assignments without project, and
        - Future trip generation and trip assignments with project
    - Table or exhibit showing level of service for existing conditions, future conditions without project, and future conditions with project
    - Summary of findings
    - Required improvements to maintain "standard level of service", and
    - Map showing location of site, recommended improvements, and other significant issues.
- Table of Contents
- An Introduction that includes:
    - A description of the project
    - Limits of the study,
    - Assumptions used in the analysis, and
    - Methodology used in the analysis.
- Location / Vicinity and Site Maps
    - Location map showing the development site relative to the existing street network including a north arrow, scale, and nearby streets labeled.
    - Site Plan showing the access points and type of development including north arrow, scale, and nearby streets labeled.
    - Area of Influence of the project (may be shown on the location map)
- Analysis
    - Trip Generation for the development including trip generaton rates used and a source for those rates (in a table),
    - Trip Distribution Map of the development-generated traffic over the street network, including the source of data and percentage splits (can include tabular and text information),
    - Map of Existing Traffic Conditions for the street network, including traffic volumes, directional distributions, and turning movements for intersections under study within the area of influence, with intersection capacity analyses for both AM and PM peak hours of travel,
    - Map of Future Traffic Conditions including level of service analysis at build-out WITHOUT the development for AM and PM peaks,
    - Map of Future Traffic Conditions including level of service analysis at build-out WITH the development for AM and PM peaks
    - Sufficient text to explain the contents, assumptions, methodology, and observations related to each map.
- Conclusion and recommendations
    - Table showing following for ADT and peak hour:

        - Existing trip generation and traffic volumes (ADT and Peak)
        - Future trip assignments without project, and
        - Future trip generation and trip assignments with project
    - Table showing level of service for existing conditions, future conditions without project, and future conditions with project
    - Summary of findings
    - Required improvements to maintain "standard level of service", and
    - Map showing location of site, recommended improvements, and other significant issues.
- Appendices
    - Turning Movement Count Reports for the intersections and time periods specified
    - Traffic Count Reports for any traffic counts that were made by the applicant
    - Copies of all analyses prepared for the existing, background, and total traffic volumes
    - Other appropriate data used and calculations made to reach conclusions.

The Executive Summary must stand alone so that it can be included in the case report for any Planning and Zoning Commission or City Council action. The full report will remain in the case file in the Planning and Development Department.

Table 1: Trip Generation for Zoning Classifications in Springfield, Missouri									
Zoning Class	Description	Trip Rate (Trips per Acre)							
		Daily Trips	AM Peak	% In	% Out	PM Peak	% In	% Out	Explanation (Assumed intensity (units or floor area ratio) for daily / AM peak / PM Peak trip rates)
R-SF	Single Family Residential	48	4	25	75	5	64	36	5 units per acre at 9.6/0.75/1.01 trips per dwelling
R-TH	Residential Townhouse	60	5	16	84	6	67	33	9 units per acre at 6.6/0.51/0.62 trips per dwelling
R-LD	Low Density Multi-Family Residential	120	9	16	84	11	67	33	18 units per acre at 6.6/0.51/0.62 trips per dwelling
R-MD	Medium Density Multi-Family Residential	180	14	16	84	17	67	33	27 units per acre at 6.6/0.51/0.62 trips per dwelling
R-HD	High Density Multi-Family Residential	240	18	16	84	22	67	33	36 units per acre at 6.6/0.51/0.62 trips per dwelling
R-MHC	Manufactured Home Community	34	3	21	79	4	62	38	7 units per acre at 4.8/0.40/0.56 trips per dwelling
O-1	Low Intensity Office	240	34	88	12	44	17	83	0.35 FAR at 16/2.26/2.9 trips per 1,000 SF*
O-2	Medium Intensity Office	480	70	88	12	65	17	83	1.0 FAR at 11/1.6/1.5 trips per 1,000 SF
GI	Government and Institutional Use	Traffic Study Required for Land Use Intensity Requirements of Each Case							
L	Landmarks	Traffic Study Required for Land Use Intensity Requirements of Each Case							
PD	Planned Development	Traffic Study Required for Land Use Intensity Requirements of Each Case							
LB	Limited Business District	470	11	61	39	40	48	52	0.25 FAR at 43/1.0/3.7 trips per 1,000 SF
GR	General Retail District	720	16	61	39	67	48	52	0.30 FAR at 55/1.2/5.1 trips per 1,000 SF**
HC	Highway Commercial District	720	16	61	39	67	48	52	0.30 FAR at 55/1.2/5.1 trips per 1,000 SF**
CS	Commercial Service District	720	16	61	39	67	48	52	0.30 FAR at 55/1.2/5.1 trips per 1,000 SF**
CC	Center City District	1600	110	72	28	160	38	62	2.5 FAR (0.5 GR, 1.0 O, 1.0 R-HD)***
RI	Restricted Industrial	52	7	83	17	7	22	78	LI, ITE Trip Generation pp. 108, 109, 110
LI	Light Industrial	52	7	83	17	7	22	78	LI, ITE Trip Generation pp. 108, 109, 110
GM	General Manufacturing	63	10	83	17	10	21	79	Ind. Park, ITE Trip Generation pp. 151, 152, 153
HM	Heavy Manufacturing	39	7	72	28	8	48	52	MFG., ITE Trip Generation pp. 179 – 183
IC	Industrial Commercial	840	18	61	39	78	48	52	0.35 FAR at 55/1.2/5.1 trips per 1,000 SF**

Trip generation rate for 45,000 SF using fitted curve rather than average rate

** Trip generation rate for 200,000 SF using fitted curve rather than average rate

*** 0.5 FAR at 43/1.0/0.62 + 1.0 FAR at 11/1.6/1.5 + 29 DU at 6.6/0.51/0.62

10 SIDEWALKS, CURB AND GUTTER, AND DRIVEWAYS

10.1 SIDEWALKS

10.1.1 General. Sidewalks are required in subdivisions on at least one side of residential streets and on both sides of collector (except in certain zoning districts – See Subdivision Regulations) and arterial streets. All new constructed walks shall meet the requirements of the most current ADA Standards for Accessible Design and Public Right of Way Accessibility Guidelines (PROWAG).

10.1.2 Design. Sidewalks are to be constructed using a minimum of 4 inches of Class "A" Portland Cement Concrete with a minimum 28-day compressive strength of 4,000-psi in accordance with Chapter 6 in the General Conditions and technical Specifications. The walks shall be constructed on 4 inches of Type 1, Type 5 or Type 7 rolled stone base extended 6 inches beyond the edges. Sidewalk sections for curb ramps and across residential drives shall be constructed with a 6 inch thickness, and 8 inches across commercial drives. The additional thickness at driveways shall extend 18 inches into the adjacent sidewalk on both sides of the driveway.

10.1.2.1 Sidewalk Plan. A plan must be prepared showing the sidewalk in plan, profile, location of ADA ramp, location and details of expansion joints, and typical cross section. This plan may be included as part of the street plan. For sidewalks to be constructed on unimproved streets, it is necessary to obtain sufficient field data to determine the probable future grade of the street curb and design the sidewalk accordingly. Additional right-of-way to accommodate the roadside drainage may have to be provided.

10.1.3 Location. The outside edge of the sidewalk shall be placed 1 foot inside the street right-of-way line.

10.1.4 Width. Sidewalks shall be a minimum width of 5 feet.

10.1.5 Sidewalk Cross-Section Grade. The maximum cross slope for sidewalks shall be 50:1 (2%). For sidewalks located across a driveway entrance, the driveway grade may need to be adjusted to meet this maximum. For commercial and other areas where a wide sidewalk creates grade problems for access drives, it should be noted that only the minimum sidewalk width of 4 feet must be constructed at a maximum 2 percent cross slope across the entrance. The remaining width of the sidewalk may be constructed at a grade closer to that of the drive. For commercial entrances, joint lines should delineate the portion of the sidewalk that crosses the driveway so it is clear where the sidewalk crosses the entrance.

10.1.6 Longitudinal Grade. The grade of the sidewalk shall not exceed 5% or the grade established for the adjacent roadway within the Right-of-Way.

10.1.7 Parkway and Drainage. The parkway cross-sectional grade (the area between the sidewalk and the street) shall be a minimum of 2 percent.
10.1.7.1 Drainage from properties adjacent to the sidewalk shall not drain across the surface of the sidewalk nor shall the grade of the sidewalk be constructed that water would pond on the surface of the walk.

10.1.8 Obstructions. All obstructions are to be removed or relocated to provide a clear minimum horizontal width of 48 inches and a clear vertical height of 80 inches. In the case where the sidewalk must be shifted a 5:1 taper to and away from the obstruction with a straight section adjacent to the obstruction should be followed.

10.1.9 Retaining Walls. When the sidewalk construction requires the installation of retaining walls to maintain or support adjacent improvements, the detailed plans shall include the wall design. Unless otherwise approved by the City, all retaining walls should be located on private property.

10.1.10 Joints. The sidewalk shall be constructed such that panels are formed using control joints that are cut such that the resulting panel lengths are not less than 4 feet nor greater than 6 feet. Edges of the slab shall be edged with an edging tool that has a ¼-inch radius.

10.1.10.1 Expansion Joints shall be placed, between the sidewalk and all structures such as light standards, traffic light standards, traffic poles, columns, on each side of driveways, intersecting walks, utility covers, or other locations when against a substantial structure. Expansion joints should also be placed as close to each property line as reasonable and at intervals not greater than 100 feet. Expansion joints hall be constructed by installing ½" thick bituminous preformed material for the full depth of the concrete precut to the width of the sidewalk.

10.1.10.2 Construction joints shall be installed at the end of each day's work and at other times when the process of depositing concrete is stopped for 30 minutes or more.

10.1.11 Ramps. Curb ramps are to be installed at all intersections and at certain mid-block locations on all new or reconstruction projects.

10.1.11.1 Running Slope. The running slope shall be 12:1 maximum.

10.1.11.2 Cross Slope. The cross slope shall be 50:1 maximum.

10.1.11.3 Landing. A minimum landing of 60 inches by 60 inches shall be provided at the top of the curb. Running and cross slopes shall be a maximum of 50:1.

10.1.11.4 Flares. Flared sides with a maximum slope of 10:1, measured along the curb line, shall be provided where a circulation path crosses the curb ramp.

10.1.11.5 Surfaces. Storm sewer intakes, grates, access covers, or other appurtenances shall not be located on curb ramps, landings, and gutter areas within the pedestrian access routes. All ramps shall have a textured, non-skid surface.

10.1.11.6 Grade Breaks. Grade breaks shall not be permitted on curb ramps, landings or gutter areas within the pedestrian access route. The grade break between the gutter area and street at the foot of a curb ramp shall not exceed 13 percent.

10.1.11.7 Drainage. Drainage from properties adjacent to the sidewalk shall not discharge a concentrated flow across the surface of the sidewalk nor shall the grade of the landing or sidewalk be constructed that water would pond on the surface of the ramp.

10.1.11.8 Islands. Any raised islands in crossings shall be cut through level with the street or have curb ramps at both sides and a level area at least 48 inches long between the curb ramps in the part of the island intersected by the crossings.

10.1.12 Detectable Warning Surfaces. Detectable warning surfaces consisting of truncated domes aligned in a square grid pattern shall be provided where a curb ramp or landing connects to a crosswalk.

10.1.12.1 Location. The detectable warning surfaces shall be located so that the nearest edge is 6 inches minimum to 8 inches maximum from the face of the curb line and the far edge is no more than 5 feet from the back of curb line. The detectable warning surface shall extend a minimum of 24 inches in the direction of travel and the full width of curb ramp.

10.1.12.2 Dome Size. Truncated domes shall have a diameter of 0.9 inch at the bottom, a diameter of 0.4 inch at the top, a height of 0.2 inch and a center-to-center spacing of 2.35 inches measured along diagonal of a square arrangement.

10.1.12.3 Visual Contrast. There shall be a minimum of 70 percent contrast in light reflectance between the detectable warning and the adjoining surface. The coloring shall be red and homogeneous and made an integral part of the detectable warning surface.

10.1.13 Design Checklist for Sidewalks

_____ Sidewalks shown in plan and profile on at least one side of residential streets and on both sides of collector and arterial streets (Check Subdivision Regulations for exceptions).

_____ Sufficient field data is shown for unimproved streets to determine probable future grade of street curb and sidewalks are designed accordingly.

_____ Typical cross sections shown with plan and profile.

_____ Outside edge of sidewalk is placed 1 foot inside of right-of-way line.

_____ 1/2-inch expansion joints are indicated on the plans.

_____ Sidewalk minimum width – 60” minimum thickness of 4” (or 6” when sidewalk crosses a residential driveway or 8” when sidewalk crosses a commercial driveway or alleys) placed on 4 inches of compacted base stone extending 6” beyond the edges of the walk.

_____ Sidewalk cross slope not greater than 1:50 (2%).

_____ All ramp slopes are a maximum of 1:12.

_____ Maximum rise for any length of run is 30”.

_____ Level landing areas provided at top and bottom of each run.

_____ Detectable warning system indicated on all curb ramps .

_____ Curb ramps provided wherever sidewalk crosses a curb.

_____ Minimum width of curb ramp is 60 inches.

_____ Accessible crossing area indicated on any raised island crossing.

_____ Hand railing indicated where elevation change between sidewalk and adjacent grade is 30” or more.

_____ Drainage from properties adjacent to the sidewalk does not discharge a concentrated flow across the surface of the sidewalk and the grades of the sidewalk ramps do not allow areas of surface ponding.

10.2 CURB AND GUTTER

10.2.1 General. Curb and gutter are required on all public improvement street projects.

10.2.2 Design. Curb and gutter are to be constructed from Class “A” Portland Cement Concrete with a minimum 28-day compressive strength of 4,000-psi in accordance with Chapter 6 in the General Conditions and technical Specifications. The curb and gutter shall be constructed on 4 inches of Type 1, Type 5, or Type 7 rolled stone base extending a minimum of one foot behind the back of the curb section. The width of the curb and gutter is to be 2 feet 6 inches. The curb height is to be 6 inches, and the gutter cross slope is to be 2 inches in 2 feet. The thickness of the gutter shall be 6 inches for residential streets and 8 inches for collector streets and above. At driveway locations shown on the plans, the gutter profile is to be carried across the drive while the curb is depressed to match the driveway slope. If driveway locations are now shown on the plans, curbs cannot be depressed.

10.2.3 Expansion Joints. Bituminous preformed expansion joints, ½ inch thick and precut to the exact cross section of the curb and gutter shall be placed at all driveway and intersection radii and at intervals of not more than 200 feet.

10.2.4 Design Checklist for Curb and Gutter

_____ Curb and gutter is provided for on all improved streets.

_____ Street profile shows centerline elevations.

_____ Curb cross section shows curb height and width 6 inches.

_____ Gutter thickness is shown as 6 inches for local residential streets.

_____ Gutter thickness is shown as 8 inches for non-residential local streets and collector residential streets.

_____ Curb and gutter is constructed on 4 inches Type I rolled stone base extending a minimum of one foot behind the curb.

_____ Total curb and gutter width is shown as 2 feet 6 inches.

_____ Gutter cross slope is 1 inch/ft (except at ramp areas).

_____ ½ inch expansion joints indicated at all driveways and at intervals of not more than 200 feet.

10.3 DRIVEWAYS

10.3.1 General. Driveway approaches are located to serve the operation of automobiles and other vehicles from the street pavement to a garage, parking area, building entrance, structure, or other approved use located on the property.

10.3.2 Residential Design. Residential driveway approaches shall be constructed using Class "A" Portland Cement Concrete with a minimum 28-day compressive strength of 4000-psi in accordance with Chapter 6 in the General Conditions and Technical Specifications. All driveway pavement shall be constructed on 4 inches of Type 1, Type 5, or Type 7 rolled stone base. When a driveway approach intersects an existing 4-inch thick sidewalk, the area of the sidewalk within the driveway area including both sides of the sidewalk transition sections to meet the drive elevation or 18 inches, whichever is greater, shall be removed and reconstructed with 6-inch thick concrete. The cross slope of the sidewalk area is not to exceed 1:50 (2%). The grade of the driveway approach from the gutter line shall rise on a constant grade to the front edge (street side) of the sidewalk area. The slope of the driveway approach shall be at least 1:50 and not to exceed 1:8.

The width of residential driveway approaches shall not exceed 22 feet without permission from City Traffic Engineer and shall not be less than 12 feet for new construction. The width of a driveway is measured at the Right-of-Way line.

10.3.3 Commercial Design. Commercial/non-residential driveway approaches shall be constructed 8 inches thick using Class "A" Portland Cement Concrete with a minimum 28-day compressive strength of4,000-psi in accordance with Chapter 6 in the General Conditions and technical Specifications. All driveway pavement shall be constructed on 4 inches Type 1, Type 5, or Type 7 rolled stone base. When a driveway approach intersects an existing 4-inch thick sidewalk, the area of the sidewalk within the driveway area, including both sides of the sidewalk transition sections to meet the drive elevation or a minimum of 18 inches shall be removed and reconstructed with 8-inch concrete. The cross slope of the sidewalk area is not to exceed 1:50 (2%). The grade of the driveway approach from the gutter line shall rise on a constant grade to the front edge (street side) of the sidewalk area. The slope of the driveway approach shall be at least 1:50 and not to exceed grade shown in the following Table for various street classifications. The width of commercial driveway approaches shall not exceed 45 feet and shall not be less than 26 feet wide. Driveway intended for use of trucks on a roadway that is less than 30 feet wide may be built as wide as 52 feet. The width of driveways is measured along the Right-of-Way line. One-Way driveways shall be a minimum of 14 feet and a maximum of 22 feet wide.

10.3.3.1 Table for determining the driveway grade for various street classifications.

Street Classification	Approach Grade	Maximum Grade Back of Sidewalk	Slope 10 feet of R/W
Major Arterial	2% to 4%	4%	-2% to 6%
Secondary Arterial	2% to 5%	5%	-3% to 7%
Collector	2% to 6%	6%	-4% to 8%
Non-Resident Local	2% to 8%	8%	-6% to 10%

10.3.4 Approach Location. Driveway spacing is restricted by the Springfield Subdivision Regulations and the Springfield City Code. Zoning cases, planned developments and subdivisions are subject to the access restrictions as set forth in Section 411 in the Springfield Subdivision Regulations. All other development must as a minimum requirement meet the driveway ordinance, Section 98-116 through 98-118 of the Springfield City Code.

10.3.4.1 No driveway approach shall be permitted which will interfere with any existing parking meters, signs, traffic control devices, planting, cables, poles, guys, water mains, gas mains, or other public utilities.

10.3.4.2 No part of any driveway approach may be located within 4 feet of a drop inlet or other drainage structure or a pedestrian ramp.

10.3.4.3 No part of any driveway approach shall be located within 40 feet of a point on the right-of-way opposite the end of a raised median.

10.3.4.4 Joint driveway approaches shall be permitted only if there is a perpetual mutual access agreement approved by the City Attorney and filed of record in the Greene County Recorder's Office.

10.3.4.5 All driveway approaches shall be located to meet the spacing shown in the following table and provide the following minimum clearances: Nearest edge of the driveway to nearest right-of-way line of alleys, 10 feet; nearest edge of the driveway to property line, 5 feet; on corner lots, nearest edge of the driveway to nearest right-of-way line of an intersecting street, 20 feet, but in no case shall the driveway return extend closer than 15 feet to the intersection right-of-way line extended. Where sight distance triangles exist, the nearest edge of the driveway to nearest corner of triangle shall be at least 20 feet.

Access on Street		Distance of Access Restrictions from Near Right-of-Way Line/Triangle of Cross Street						
		Expressway	**Primary Arterial**	**Secondary Arterial**	**Collector**	**Non-Residential Local**	**Residential Local**	**Driveway**
Expressway	Approach	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted
	Exit	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted	Not Permitted
Primary Arterial	Approach	350 ft*	300 ft*	250 ft*	200 ft	200 ft	200 ft	200 ft
	Exit	250 ft	200 ft	200 ft	200 ft	200 ft	200 ft	200 ft
Secondary Arterial	Approach	300 ft*	250 ft*	200 ft*	150 ft	150 ft	150 ft	150 ft
	Exit	150 ft	150 ft	150 ft	150 ft	150 ft	150 ft	150 ft
Collector	Approach	250 ft*	200 ft*	150 ft*	100 ft	100 ft	100 ft	100 ft
	Exit	100 ft	100 ft	100 ft	100 ft	100 ft	100 ft	100 ft
Non-Residential Local	Approach	200 ft*	150 ft*	100 ft	50ft	30 ft	20 ft	20 ft
	Exit	100 ft	75 ft	50 ft	50 ft	30 ft	20 ft	20 ft
Residential Local	Approach	150 ft	100 ft	70 ft	50 ft	30 ft	20 ft	20 ft
	Exit	70 ft	50 ft	30 ft	30 ft	30 ft	20 ft	20 ft

*Where a median is on a street, the recommended access restrictions for the approach side are the same as for the exit side.

10.3.4.6 Edges of the driveway approach may be skewed so that the angle between the street right-of-way line and the edge of the driveway approach is not less than 60 degrees.

10.3.4.7 Radius of the driveway approach shall not, in any case, extend beyond the projection of the adjacent property line, extended perpendicularly to the right-of-way line.

10.3.4.8 The radius of a driveway return shall not extend beyond the right-of-way line or 15 feet, whichever is smaller.

10.3.5 Expansion Joints. The plans shall show bituminous 1/2-inch thick preformed expansion joints to be placed at the right-of-way and sidewalk connections.

10.3.6 Existing Curb and Gutter. The plans shall show the existing curb and gutter section in front of a driveway (radius point to radius point) shall be saw cut full depth and removed before the driveway is constructed. The entire curb and gutter section would then be reconstructed the same concrete and depth as the driveway approach.

10.3.7 Design Checklist for Driveways

_____ Existing and proposed driveway locations must be indicated on the plans.

_____ All driveway dimensions including slope and elevations/contours are shown.

_____ Locations of access drives, alleys and intersections within 250 feet of site and across the street are shown.

_____ Driveway approach is located 40 feet beyond the end of a raised median.

_____ Show that driveway approaches do not interfere with any existing parking meters, signs, traffic control devices, plantings, cables, poles, guys, water mains, gas mains, or other public utilities.

_____ Show that all landscaping within 5 feet of the street does not affect sight distance at the driveway.

_____ Copy of approved joint driveway approach agreement filed in the Greene County Recorder's Office.

_____ Width of residential driveway approach at right-of-way line is not less than 12 feet or more than 22 feet. Width of commercial driveway approach at right-of-way line is not less than 26 feet or more than 45 feet.

_____ Approach not within 4 feet of a drop inlet or other drainage structure or pedestrian ramp.

_____ Approach grade of driveway does not exceed the maximum allowed per the street classification.

_____ Nearest right-of-way of alley – 10 feet.

_____ Nearest edge to property line – 5 feet.

_____ If corner lot, nearest edge to nearest right-of-way of intersecting street – 20 feet.

_____ Approach skewed to not less than 60 degrees between street right-of-way line and the edge of the driveway approach.

_____ Radius of driveway approach not extended beyond the projection of the adjacent property line.

_____ Radius of driveway return is designed for the classification of street and type of vehicle use.

_____ Expansion joints indicated.

_____ Cross slope of sidewalk area within the driveway must not exceed 1:50 (2%).