City of Springfield, Missouri

Design Standards for Public Improvements

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1 DEFINITIONS AND POLICIES

1.1 DEFINITION OF TERMS, PHRASES, AND WORDS

1. **Alley.** A minor way which is used primarily for vehicular service access to the back or the side of properties otherwise abutting a street.

2. **Arterial Street (Primary).** A street or highway primarily intended to provide for high volume, moderate speed, and extended trip length traffic movement between major activity centers, with access to abutting property subordinate to major traffic movement.

3. **Arterial Street (Secondary).** A Street which interconnects with and augments the major arterial system. The secondary arterial is primarily intended to provide for moderate volume, moderate speed, and short to moderate trip length while providing partially controlled access to abutting property

4. **Bench Mark.** A permanent object of known elevation and location that is in an area where disturbance is unlikely.

5. **Block.** A piece of parcel of land entirely surrounded by public highways, streets, streams, railroad right-of-way, parks, or a combination thereof.

6. **Bridge.** A structure having a clear span greater than twenty (20) feet or a multiple span structure where the total length of the span is in excess of twenty (20) feet.

7. **City of Springfield Standard General Conditions and Technical Specifications for Public Works Construction.** The official General Conditions and Technical Specifications used on public city improvements within the City of Springfield, Missouri. This document contains data for public improvements from the advertising stage of a project through the actual construction and acceptance of the project.

8. **Collector Street.** A street which collects and distributes traffic to and from local and arterial street systems. The collector is primarily intended to provide for low to moderate volume, low speed, and short length trips while providing access to abutting property.

9. **Consultant.** An individual, firm, association, partnership, corporation, or other legal entity registered in the State of Missouri and engaged in the practice of engineering or architecture.

10. **Corner.** A point of intersection of lines of two street curb faces extended into street intersection.

11. **Crosswalk.** A right-of-way, dedicated to or set aside for public use, which cuts across a block or street to facilitate pedestrian access to adjacent streets and properties.

12. **Cul-de-sac or Dead-end Street.** A minor street with only one outlet.

13. **Culvert.** A structure not classified as a bridge, which provides a conduit for drainage.

14. **Curb Return.** The portion of curb at the beginning of a driveway approach, which serves as a transition from the height of the curb to the level of the approach.

15. **Driveway.** An area intended for the operation of automobiles and other vehicles from the street right-of-way line to a garage, parking area, building entrance, structure, or approved use located on the property. Any dimensions relating to the width of a driveway or driveway surface shall be measured at the right-of-way line.

16. **Driveway Approach.** An area intended for the operation of automobiles and other vehicles giving access between a roadway and abutting property. The driveway approach includes the sum of the curb returns on each side of the driving surface, plus the driving surface.

17. **Easement.** A grant by the property owner to the public, a corporation, or persons of the use of land for specific purposes.

18. **Expressway.** A street or highway with limited and partially controlled points of access at arterial system intersections. The expressway is primarily intended to provide for high volume, moderate to high speed extended intra-city traffic between major activity centers with minimal impairment to movement.

19. **Freeway.** A divided highway with fully controlled access limited to grade-separated interchanges constructed at major thoroughfares. A freeway is primarily intended to provide for high-volume, high-speed intercity traffic movements.

20. **Gutter.** That portion of the driving surface of an improved street, driveway, approach, or other public way, which abuts the curb and provides for the runoff of surface drainage.

21. **Improved Street.** A public street having concrete curbs, or curb and gutters, or other such equivalent physical features, which serve to establish a permanent street grade.

22. **Intersection.** The general area where two or more roadways meet, join, or cross at a common point establishing an area within which vehicles traveling different roadways may come in conflict.

23. **Joint Driveway.** A driveway which provides access to a public street for more than one parcel of land.

24. **Local Street.** A street primarily providing direct access to abutting property and designed to accommodate low-volume, low-speed traffic.

25. **Lot.** An undivided tract or parcel of land under one ownership having access to a street, whether occupied or to be occupied by a building or building group together with accessory buildings, which parcel of land is designated as a separate and distinct tract, and is identified by a tract or lot number or symbol in a duly approved subdivision plat filed of record.

26. **Owner.** The City of Springfield, Missouri, its agents, employees, and representatives, with whom Contractor has entered into the Agreement and for whom the Work is to be performed.

27. **Parkway.** That portion of the street right-of-way between the edges of the roadway and the adjacent property line, or lines, on the same side of the street except any portion used for sidewalks.

28. **Preliminary Plat.** The preliminary map, drawing, or chart indicating the proposed layout of the subdivision initially required in the subdivision process.

29. **Property Description.** Description of a lot, tract, or parcel by metes and bounds, by reference to a plat or by reference to government survey.

30. **Property Line.** The boundary between two or more parcels of land.

31. **Public Improvements.** Those things that are constructed, installed, or performed on public land, or on land that is to become public in the subdivision process, including but not limited to street and alley pavement, curbs, storm drainage facilities, sidewalks, and sanitary sewers, and including the grading of such land.

32. **Reference Points.** Points of reference located by a survey of the project. The points are to be tied or referenced to at least three identifiable features.

33. **Right-of-Way.** A general term denoting public ownership or interest in land, usually in a strip, which has been acquired for or devoted to the use of a street or alley.

34. **Right-of-Way Line or Street Right-of-Way Line.** The boundary between any public street or alley and one or more parcels of private property.

35. **Roadway.** That area of a street intended and used for vehicular travel.

36. **Service Road.** A minor street which is parallel and adjacent to an arterial street and which provides access to abutting properties and protection from through traffic.

37. **Shall, May.** The word “Shall” shall be deemed as mandatory. The word “May” shall be deemed as permissive.

38. **Sidewalk.** That paved portion of a parkway intended for the use of pedestrians.

39. **Sight Distance Triangle.** A triangular-shaped area of street right-of-way, generally acquired at major intersections to ensure adequate sight distance.

40. **Storm Water Detention Facility.** A drainage facility designed and constructed for the purpose of detaining storm water runoff to reduce downstream flows and/or reduce storm water pollutant levels.

41. **Streets.** "Street" is a way for vehicular traffic, whether designated as a street, highway, thoroughfare, parkway, throughway, road, avenue, boulevard, lane, place, or however otherwise designated.

42. **Subgrade.** The surface of a street on which a base course or riding surface is to be placed.

43. **Subdivision.** The division of land into two (2) or more lots, tracts, or parcels for the purpose of transfer of ownership or building development, or, if a new street or easement of access is involved, any division of a parcel of land. The term includes resubdivision and, when appropriate to the context, shall relate to the process of subdividing or to the land subdivided.

44. **Surveying.** The act of determining the positions of points on the earth's surface by means of measurement of distance, direction, and elevation.

45. **Tendering**. The legal transfer of ownership and maintenance responsibility of a public improvement to the City of Springfield.

46. **Unimproved Street.** A street not having concrete curbs, or curbs and gutters, or other such equivalent physical features which serve to establish a permanent street grade.

47. **Vehicle.** Every device in, upon, or by which any person or property is, or may be transported, or drawn upon a street, except devices used exclusively upon stationary rails or tracks.

1.2 PUBLIC WORKS POLICIES

1.2.1 Minimum Standards for Design. The Director of Public Works must approve all plans for public improvements within the City of Springfield. This approval is a conceptual approval only and does not give detail approval to any particular design item or data shown on the plans, nor does it give approval for any deviation from City specifications unless that deviation is shown on the plans by a general note. The Engineer who sealed the plans is responsible for all lines and grades, field data, constructability of the design, and all other items affecting the project including compliance with the City specifications.

1.2.2 Variance from minimum standards.

All design requirements will be strictly adhered to unless written justification for a design variance, sealed by a professional engineer is presented and approved. This justification should be submitted along with the preliminary plat and variance applications which will be reviewed

by the Administrative Review Committee and approved by the Planning and Zoning Commission and City Council.

Should a request for a design variance occur after preliminary plat approval, the sealed justification for a design variance, variance application and any required amendment to the preliminary plat must be resubmitted to the Planning and Zoning Commission and City Council for approval. Substantial changes would require a new preliminary plat.

1.2.3 Acceptance of Public Improvements. No streets, alleys, sanitary sewers, storm sewers, or other public improvements will be accepted or approved by either the City Council or Director of Public Works, unless the improvements were constructed in accordance with Plans, Special Provisions, and Technical Specifications approved by the Director of Public Works.

1.2.4 Utility Location Policies

1.2.4.1 General. The following criteria has been established for the uniform treatment of the location or relocation of utility facilities within the right-of-way of the public street system in order to preserve the traffic-carrying capacity of the street and to minimize interference with normal maintenance operations. These requirements apply to all public and private utilities including power transmission, telephone, cable television, telegraph, water, gas, oil petroleum products, pipelines, and any other utility facilities (excluding Sanitary Sewers). The requirements apply to underground, surface, or overhead facilities located within or crossing street right-of-way. Exceptions to the requirements set forth will be considered when major utility extensions are proposed or when improvements by their size necessitate special consideration. All utilities installing any facilities in a public right-of-way must meet the requirements of the Department of Public Works and shall receive advance approval from Public Works prior to commencing construction on a public right-of-way. In order to receive approval, an engineering drawing detailing the installation shall be required. This engineering drawing shall depict adequate data to determine location and impact on other facilities located in the public right-of-way.

In the case of reconstruction or rehabilitation where location of existing utilities will not be relocated and where breaks or normal maintenance is needed, the requirement for an engineering drawing shall be waived.

1.2.4.2 New Subdivisions – Residential. Parallel installations of overhead facilities within the street right-of-way are to be located within one (1) foot of the right-of-way line when proposed for construction on the same side of the street that sidewalks are constructed. Street lights and poles used to support transverse crossings of the right-of-way shall not be located closer than two (2) feet of the curb or edge of roadway or paved shoulder. Poles, guys, anchors, braces, and other appurtenances for overhead facilities shall not encroach into sidewalk or streets. Parallel installation of overhead facilities and underground facilities, including meters, valves, and other appurtenances, within the street right-of-way, are to be located within a seven (7) foot area adjacent to the right-of-way line where no sidewalks exist. In no case will the City allow the facility to be constructed within the street pavement area except for valves necessary for tapping existing facilities, nor will it be allowed to conflict with the street drainage. Careful consideration must be given to the location of valves, meter boxes, and other appurtenances, so that

interference with the sidewalk and street curb is held to a minimum. Minimum cover for all underground facilities shall be 36 inches.

1.2.4.3 New Subdivisions – Nonresidential. Parallel overhead and underground facilities are to be located within seven (7) feet of the right-of-way line. Street lights and poles used to support transverse crossings of the right-of-way shall not be located closer than two (2) feet of the curb or edge of roadway or paved shoulder. Poles, guys, anchors, braces, and other appurtenances for overhead facilities shall not encroach into sidewalks or streets. Parallel installation of the underground facilities, including meters, valves, and other appurtenances, within the street right-of-way, are to be located within seven (7) feet of the right-of-way line. In no case will the City allow the facility to be constructed within the street pavement area except for valves necessary for tapping existing facilities, nor will it be allowed to conflict with the street drainage. Careful consideration must be given to the location of valves, meter boxes, and other appurtenances, so that interference with the sidewalk and curb is held to a minimum. Minimum cover shall be 36 inches or conforming to federal, state, or local agency requirements, whichever is greater.

1.2.4.4 Existing Subdivisions – Residential and Nonresidential. Plans developed for new underground or overhead facilities must be designed to take into account existing utilities, as well as possible future utilities. Where possible, corridors outlined in 3(b) and 3(c) are to be adhered to. Due to existing facilities, this may be impractical. Design based upon remaining corridor is encouraged, but it is understood local, state, and federal codes may make this impossible. Since existing conditions must be taken into account, deviation from the corridor requirements in 3(b) and 3(c) will be accepted.

1.2.5 Permits.

1.2.5.1 City Maintained Streets. All utility work and property improvements to be performed within the City right-of-way limits will require an excavation permit from the Public Works Department prior to the work being done by the contractor. All street, curb, and sidewalk repairs will be performed by City forces at the current rates established for such repairs or by a City-approved Contractor. In emergency situations where necessary repairs to an existing utility facility must be made immediately in order to protect the public health, safety, and welfare, a permit must be obtained as soon after emergency repairs are commenced as possible.

1.2.5.2 State Maintained Streets and Highways. All utility work to be performed on state-maintained facilities will require a permit from the Missouri Highway and Transportation Commission. All requirements of the state must be met.

1.2.5.3 Open Cutting or Boring of City Streets. As a general policy, no open cutting of the pavement will be permitted on the City's arterial or three- or four-lane collector streets except special permission to open cut an arterial or collector street may be given when the street has not yet been constructed to the ultimate design or major maintenance or rehabilitation of the street surface is programmed within three (3) years of the open cut. Boring or other tunneling methods will be allowed on all City-maintained streets. In cases where a break, leak, or malfunction occurs in an existing facility, or when spot lowerings or connections are made in rehabilitation, open cutting will be allowed as necessary to repair or rehabilitate the facility.

As additional arterial or collector streets are constructed or improved to ultimate standards, open cutting will not be permitted on these facilities except where breaks occur. The approved "Thoroughfare Improvement Program" lists those streets, which are planned for improvement in the near future.

1.2.5.4 Backfilling and Repair of Utility Cuts. When open cutting of an existing or proposed street is approved, aggregate backfill conforming to City standards must be placed for the full trench depth and compacted to six (6)-inch layers across the street to within two (2) feet of the outside of the street curbs, as well as under all sidewalks, driveways, and other structures or pavements. Any damage to existing curbs, sidewalks, and other public improvements will be repaired and/or replaced by City forces at the expense of the utility.

1.2.5.5 Utilities Constructed Through Storm Sewer Structures. Any utility found in a storm sewer structure during the course of that structure's rehabilitation or reconstruction would have to be relocated outside of the structure. Further, any new utility will be prohibited from passing through any storm sewer structure regardless of the age of the structure, and regardless of the fact that there are existing utilities in the structure. Relocation expense will be subject to Paragraph 1.2.3.9.

1.2.5.6 Reimbursement to Public Utilities. On Public Works' projects constructed either by contract or by City maintenance forces where conflicts occur with existing utilities, the utility company shall be required to relocate their existing utilities in accordance with the policies set forth in these Design Standards. Where the utility is privately owned, all costs related to the relocation will be borne by the utility.

Both the designer and the utility must make a good faith effort and agree on the approximate location of the utility. Disclaimer clauses will not be accepted as good faith effort. Charges for reimbursement must include credits for all salvageable materials and must not include costs for betterment.

1.2.6 Tree Canopy Preservation and Restoration Policy and Enhancement Goals

1.2.6.1 Purpose Statement. Provide a measured approach to tree canopy preservation and restoration and long-term tree canopy enhancement based on accepted arboricultural standards, Public Works and/or Parks project requirements by starting preservation and restoration efforts at the concept phase of the design process and assigning responsibility to future enhancement efforts. This policy designates trees as part of the existing infrastructure.

1.2.6.2 Policy. Existing tree canopy will be measured for each significant Public Works or Parks project that occurs within the urban area, excluding tax bill sewer district projects, certain grants, private development and certain specially stipulated funding. Tree canopy evaluations will only be conducted when tree canopy loss is expected or tree preservation methods are necessary. Any tree canopy that is not preserved due to construction or necessary site improvements will be replaced at or funding reserved at a value that doubles the canopy that is lost. First preference of canopy replacement will be on the corresponding Public Works or Parks project site.

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.

2.1.12 Box Culvert Design. When standard box culvert designs are referenced, the Engineer shall show and label in the drawings the size, spacing, and shape of the reinforcing and the dimensions of the structure. Box culverts should be designed for HS-20 loading at a minimum.

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 SURVEY REQUIREMENTS

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 based on the maximum hourly flow tributary to the proposed improvement determined using an average daily flow of 100 gallons per capita plus wastewater flow from industrial, major institutional, and commercial facilities, multiplied by a peaking factor derived from the following formula:

$$\text{Peaking Factor (PF)} = (18 + \sqrt{P}) \div (4 + \sqrt{P})$$
Where P = Population expressed in Thousands

Wastewater flow from industrial, major institutional, and commercial facilities can be converted to population equivalent by dividing the flow by 100 gallons per capita per day. The 100 gallons per capita figure is assumed to cover normal infiltration, but an additional allowance should be made where ground conditions are known to be unfavorable.

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 Environmental Services, no sewer shall be designed and/or constructed that will not provide a minimum depth of four (4) feet to top of pipe. All standard PVC sewer mains up to 20 feet deep shall be SDR 26 pipe. All sewers over 15 feet deep shall have a minimum of 12 inches of aggregate bedding material over the top of the pipe. Engineer shall perform calculations to select pipe type and material for sewers exceeding 20 feet in depth.

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 the Manning 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. A drop of 0.5 feet shall be shown through manholes where a Z-lok is required (pipe slope greater than 10%) 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 pressure tested to water pipe standards at a pressure not less than 150 pounds per square inch 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 Pamrex 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~~ left.

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.

5.3.2 Plan Review Checklist for Sanitary Sewers

General Information

Yes	NO	N/A	
□	□	□	Copy of the replat, lot split, or council-approved preliminary plat conditions has been provided which includes public improvement requirements
□	□	□	Two sets of drawings on ARCH D Paper (24" x 36")
□	□	□	Plans sealed, signed, and dated by Professional Engineer
□	□	□	City title block on all sheets
□	□	□	Revisions noted
□	□	□	Mains sized for drainage basin
□	□	□	Offsite sewer easements provided
□	□	□	Minimum finished floor elevations shown on the cover sheet and plan sheet and are based on: 1. Minimal lateral connection flow line elevation at main springline (four inches (4") above line of an eight inch (8") main); 2. Minimum lateral slope of ⅛ inch per foot; 3. Maintain 18 inches of cover over top of lateral; 4. Serve entire lot based on proposed two foot (2') contours Note: All minimum finished floor elevations must be shown on the final plat
□	□	□	Obtained State approval (if in state ROW)
□	□	□	Obtained appropriate permit in Building Regulations to build within a floodplain. If manholes are located in floodplain, specify waterproof lids
□	□	□	Submitted a sinkhole report and received a sinkhole permit in accordance with the sinkhole ordinance
□	□	□	Submitted plans for Land Disturbance Permit
□	□	□	Checked for proximity to brownfields or hazardous material

□	□	□	If crossing a street or concrete ditch, will the street or storm sewer department allow the structure to be cut or will it need to be bored, appropriate details shown on the plans
□	□	□	Are there special connection fees to be paid with the engineering and inspection fees
□	□	□	Install two-way clean-out at R/W or edge of easement with tracer wire full length of lateral within R/W or easement

If Sewers are proposed outside of the City Limits

Yes	NO	N/A	
□	□	□	Submitted copy of current Title Commitment and Warranty Deed for entire sewer district property. (Irrevocable Petition and Consent to Annexation)
□	□	□	Public Works provided with set of plans approved by Greene County Highway Department, if sewers are to be in county street Right-of-Way.
□	□	□	Signature block for Greene County Highway Department if sewers are in county street right-of-way or County Resource Management if crossing a stream
□	□	□	County grading permit if in County Right-of-Way or near natural resource
□	□	□	404 permit if crossing stream or other natural resource

Title Sheet

Yes	NO	N/A	
□	□	□	Name of subdivision/improvement shown
□	□	□	Name, address, and zip code of developer/owner shown
□	□	□	Location sketch shown:
□	□	□	1. Scale shown
□	□	□	2. North arrow shown
□	□	□	3. Two major streets shown
□	□	□	Site Plan shown:
□	□	□	1. Legal description given (subdivision and/or sewer district boundary)
□	□	□	a. reference made to land tie, existing subdivison or other known point
□	□	□	b. bearings and distances shown on plan and in written form
□	□	□	c. elevation contours shown over the entire sewer district
□	□	□	d. lot lines and dimension shown
□	□	□	2. Two City benchmarks referenced
□	□	□	3. North arrow shown
□	□	□	4. Correct scale shown (1” = 40’ or other appropriate)
□	□	□	Neighboring subdivision name and lot numbers shown if affected by sewer or needed for boundary description information
□	□	□	Consultant’s name, address, zip code, and phone number shown
□	□	□	Manholes on title sheet labeled
□	□	□	Sections of the main indexed by sheet number
□	□	□	All applicable standard construction notes shown
□	□	□	The “One Call” stamp and phone number shown

Plan and Profile Sheets

Plan:

Yes	NO	N/A	
□	□	□	Scale shown (1” = 40’ horizontal, 1” = 4’ vertical for undeveloped areas, 1” = 20’ horizontal, 1” = 4’ vertical for developed areas)
□	□	□	North arrows shown

□	□	□	Line types defined (if not in standards)
□	□	□	Easements shown with Book/Page numbers
□	□	□	Names shown of all landowners affected by project
□	□	□	Manholes not shown in detention. If detention is necessary, specify manhole above detention rim and grading around manhole
□	□	□	New easements dimensioned and properly described
□	□	□	Stationing of manholes shown
□	□	□	All other existing and proposed utilities and structures appear to be shown
□	□	□	Stationing in 50-foot intervals
□	□	□	Main placed in center of parkway where possible, otherwise is within an easement or right-of-way having five (7.5) feet of clearance from center of main
□	□	□	Manholes shown to not be within sidewalk
□	□	□	Bearings of main shown or angles at manholes shown with bearing reference
□	□	□	Station, size, and length of service lateral and tee shown. Tee and lateral shown to be perpendicular to main within easement or R/W
□	□	□	All end-of-line manholes shown to be 15 feet past property line
□	□	□	If adding manhole to existing sewer, the immediate upstream and downstream manhole elevations shown as shot in field, and any service laterals shown

Profile:

Yes	NO	N/A	
□	□	□	Stationing shown
□	□	□	Scale shown (1” = 40’, 1” = 4’ for undeveloped areas, 1” = 20’, 1” = 4’ developed areas)
□	□	□	Stationing of manholes shown
□	□	□	All other existing and proposed utilities and structures to be shown
□	□	□	Pipe slope, material, and size is shown
□	□	□	Z-LOK connection specified where incoming or outgoing pipe grade is greater than 10%. Manhole should have 5/10 of a foot fall through invert
□	□	□	Four feet (4’) of cover maintained over all mains
□	□	□	Plot minimum finished floor elevation at station shown on plan and show Lot number, size, and length of lateral
□	□	□	SDR 21 PVC pipe used if less than 18 inches clearance between top of sanitary sewer and bottom of storm sewer
□	□	□	SDR 21 PVC pipe present from MH to MH if sanitary sewer less than 18 inches vertical clearance of a water main. Also, note of the special testing procedures shown. (see Section 5.2.5.2).
□	□	□	Sewer main in steel casing carrier pipe or concrete encasement present if ground cover of 18 inches impossible to attain (encasement normally used only at creek crossings)
□	□	□	Note to place fill prior to sewer installation shown where fill proposed to attain four (4) feet of cover
□	□	□	Distance between manholes centers less than 500 feet
□	□	□	Minimum slope for eight (8) inch main 0.4 percent (0.5 percent preferred where possible)
□	□	□	Concrete anchors along main shown if slope exceeds 15 percent with detail
□	□	□	Trench seal specified on both sides of creek crossings with detail
□	□	□	Bank and channel protection specified at creek crossing
□	□	□	Casing and boring details shown with a minimum boring slope of one percent (1%)

□ □ □ If utilizing existing sewer, all existing and proposed service connections are shown and all manhole lid and flow line elevations are given

5.4 SEWAGE PUMPING STATIONS (LIFT STATIONS)

5.4.1 General. A sewage pumping ~~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 sewage pumping ~~lift~~ station is to serve as a sewage collection point for a development and to pump that sewage to a gravity sewer line serving the area using the most cost effective and reliable design for maintenance and operation.

Sewage pumping stations will only be considered when a 10-year life cycle cost-effective analysis comparing the construction, operation, and maintenance costs between proposed sewage pumping station and a reasonable gravity sewer alternative clearly indicates that gravity sewers are not economically feasible, per City Code Section 98-285.

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. Structures and electrical and mechanical equipment shall be protected from physical damage by the 100-year flood and remain fully operational and accessible during the 25-year flood.

5.4.2.2 Fencing. A fence surrounding the pump station site shall be provided. The fence shall be seven (7) feet high (minimum) with a fourteen (14)-foot wide, double-leaf gate. The fence shall be located to provide ten (10) feet clearance between all pump station components and the fence perimeter. Fencing shall be galvanized chain link except where subdivision rules require ~~a~~ wooden privacy fence. The gate shall be located so that entranceway does not go over manholes. The pump station and emergency generator unit ~~is to~~ shall be easily accessible for maintenance from entranceway. The gate shall be set back at least twenty-five (25) feet from edge of public street.

5.4.2.2.1 Sign. A sign containing the following wording shall be securely attached to the fence at a location clearly visible from the pump station access road:

Station Name & I.D. No. (Obtain from City)
Sewage Pumping Station
City of Springfield
No Trespassing
In Case of Emergency or Alarm
Please Call (417) 838-3082

Wording shall be centered horizontally and vertically on the sign. Sign panel shall be standard gauge aluminum sheet, minimum 30-inches by 30-inches, with black letters on white background. Top four (4) lines shall be minimum 2-inch high letters and bottom two (2) lines shall be minimum 1-inch high letters.

5.4.2.3 Surfacing of Sewage Pumping, Lift Station Area. The area inside the fence must be constructed of six (6) inches of Type 1 aggregate, compacted according to City Specifications Section 3.3.2, on a medium weight, non-woven geotextile, permeable vegetation barrier placed over the entire enclosed area.

Subgrade shall be graded to provide positive drainage away from building and structures. Maintain finished grade/surfacing a minimum of 6" below face of exposed concrete at locations around the perimeter of all structures. Slope subgrade and surfacing for adequate drainage. For all sidewalks, running slope is not to exceed 5% and cross slope is not to exceed 2% in any direction. Embankment and drainage channels shall have a maximum slope of 4:1.

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. The road shall have a minimum driving surface width of 12-feet and maximum grade of 10%. Enough room shall be provided at the site to permit turning vehicles around. Junction of pump station road and public street shall have a minimum sixteen (16)-foot-long culvert of acceptable diameter in ditch if ~~necessary~~ applicable.

5.4.2.5 Exterior Lighting. A weatherproof, pole or building mounted, exterior LED area lighting fixture with dusk-to-dawn operation shall be provided. The fixture shall be dimmable with the capability to provide an average range of illumination of one (1.0) footcandle over the entire site for security purposes and fifteen (15.0) footcandles over the wet well and equipment areas for maintenance purposes. Exterior lighting shall conform to Section 6-1400 Lighting Standards of the City of Springfield, Missouri Zoning Ordinance.

5.4.2.6 Control Building. All electrical switch~~ing~~ gear and controls ~~to~~ shall be mounted inside a weatherproof building with four (4) feet (minimum) clearance at front of electrical enclosures and a minimum ceiling height of eight (8) feet. The building may be masonry, pre-engineered metal, or pre-engineered fiberglass reinforced plastic (FRP) construction, except buildings for permanent sewage pumping stations shall be masonry construction. Building shall be securely anchored to a minimum six-inch thick steel reinforced concrete floor designed to support applied loads. Buildings shall be provided with appropriate heating and ventilation equipment. Buildings for permanent stations shall also be provided with restroom facilities and shop sink with hot and cold-water supply. Construction details and technical specifications for building shall be incorporated into the Plans and Special Provisions specific to that Project.

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 shall be non-clog, solids handling, submersible type. Submersible type grinder pumps will be considered by the City only in special cases if sufficient information is presented to justify their use. Built-in-place dry well/wet well-type stations may be acceptable for large stations and will be considered by the City on a case-by-case basis.

5.4.3.2 Structures. Pump station wet well and valve vault shall be constructed of either pre-cast or poured-in-place reinforced concrete. Precast structures shall conform with ASTM C478 and ASTM C890. Poured-in-place structures shall conform with Chapter 6 of the General Conditions and Technical Specifications.

5.4.3.2.1 Buoyancy. Where high groundwater conditions are anticipated, buoyancy of the pump station structures shall be considered and, if necessary, adequate provisions shall be made for protection.

5.4.3.2.2 Separation. Wet and dry wells, including their superstructure, shall be completely separated. Common wall construction between wet and dry wells may be permitted provided there is no interconnection between the wet well and dry well atmospheres.

5.4.3.2.3 Pump Removal. Provision shall be made to facilitate removing pumps, motors, and other mechanical and electrical equipment.

- **A.** Submersible pump stations shall have a quick disconnect connection and guide rail lifting system for each pump. A stainless-steel lifting chain, with one end permanently attached to the pump-lifting bail and the other end secured to a stainless-steel hook at grade level, shall be provided for each pump.
- **B.** Dry well/wet well stations shall have a hoist and trolley system to lift and move the pumps to the access opening. System shall have a minimum lifting capacity equal to 150% of the maximum combined pump and motor weight.
- **C.** Where pump station is enclosed in a building, the hoist and trolley system described above shall be capable of moving pumps and motors to the access doorway.

5.4.3.2.4 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 shall have rest landings at vertical intervals not exceeding ten (10) feet. Such stairways and ladders shall be OSHA compliant.

5.4.3.3 Pumps.

5.4.3.3.1 Design. Submersible pumps shall be designed so that it is not necessary to disconnect piping, valves, electrical circuits, and other appurtenances in the wet well when the pumps are removed for service or replacement.

5.4.3.3.2 Multiple Units. At least two (2) pumps shall be provided. If only two (2) units are provided, they must have the same capacity. Each pump shall be capable of handling the design peak hourly flow. Where more than two (2) units are provided, each unit must be of such capacity that with any one unit out of service the remaining units will have capacity to handle the design peak hourly flow.

5.4.3.3.3 Protection Against Clogging. Pumps handling sanitary sewage from thirty (30)-inch or larger sewers shall be protected with a sewage grinder designed for open channel installation upstream of the wet well or for wall mounting in front of the influent pipe within the wet well. Appropriate protection from clogging should also be considered for pumping stations receiving flow from sewers less than thirty (30)-inch where the waste stream may warrant. Construction details and technical specifications for such installations shall be included in the Plans and Special Provisions specific to that Project.

5.4.3.3.4 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.

5.4.3.3.5 Priming. The pump shall be so placed that under normal operating conditions it will operate under a positive suction head

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

5.4.3.3.7 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. The sump pump discharge line shall be provided with dual check valves and coupling to facilitate sump pump removal for maintenance. 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.

5.4.3.3.8 Submersible Pump Seals. Tandem mechanical seals are required on submersible pumps. Seal faces shall be tungsten carbide.

5.4.3.4 Piping and Valves. Station piping shall be at least four (4) inches in diameter. A shut-off valve shall be placed on the discharge line of each submersible pump. For dry pit stations, shut-off valves shall also be placed on the suction line of each pump.

A check valve with external spring (or weight) and lever shall be placed on each discharge line between the shut-off valve and the pump. Each check valve shall be equipped with a lever-

operated micro switch for common alarm telemetering purposes. Valves on the discharge side of each pump shall be provided with instrument ports.

For submersible stations, these valves shall be located inside a valve vault separate from the wet well and shall be readily accessible for repairs. Dismantling joint fittings should be provided adjacent to valves to facilitate installation or removal of valves.

5.4.3.5 Wet Wells.

5.4.3.5.1 Sizing. The design fill time and minimum pump cycle time shall be considered in sizing the wet well. The effective volume of the wet well shall be based on the design average daily flow determined in accordance with Section 5.2.3.1 of these Design Standards and a filling time not to exceed 30 minutes, unless the facility is designed to provide flow equalization. The pump manufacturer's duty cycle recommendations shall be utilized in selecting minimum cycle time. For constant speed pumps the minimum cycle volume shall be based on the following formula:

$$Vr_{min} = (T \; x \; Q) \div (4)$$

Where:
Vr_{min} = Required minimum pump cycle volume between pump-on and pump-off, gallons
T = Required time between pump starts, minutes
Q = Pump discharge capacity, gallons per minute

5.4.3.5.2 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.

5.4.3.5.3 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.

5.4.3.5.4 Sump. Wet well sump design shall provide for proper approach flow to the pumps and prevent accumulation of sediments. The wet well floor shall be sloped to direct flow toward the pump inlets with a minimum of localized swirl and air-entraining vortices and include fillets or benching to prevent sedimentation. For larger wet wells, a properly placed baffle wall close to the inlet should be considered to reduce the potential for localized swirl and vorticity. Water levels during pump cycling must be great enough suppress surface vortices yet lowered as much as possible at intervals to increase velocity and turbulence.

5.4.3.6 Ventilation. Adequate ventilation shall be provided for all pump stations. For submersible type stations, passive ventilation of the wet well will be adequate and shall consist of a 4-inch stainless steel or aluminum vent pipe extending at least 18-inches above top of wet well with a return bend and stainless-steel insect screen. In dry well/wet well stations, mechanical ventilation of the dry well is required. Mechanical ventilation of the wet well is also

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~~ access cover 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 (1) inch. A freeze-proof hydrant with hose bib and vacuum breaker shall be located within ten (10) feet of pumping station but not in the traffic path. Water supply to the pump station site shall be protected by a reduced pressure type backflow preventer. Backflow preventer piping shall be provided with unions and isolation valves to allow removal for maintenance.

5.4.3.8 Dry Well, Wet Well and Valve Vault Access. Suitable and safe means of access shall be provided to pump station dry wells, wet wells, and valve vaults. Access covers and frames shall be aluminum construction and sized to provide adequate clearance for removal of pumps, motors and other equipment. Access cover frames shall be extruded aluminum angle frame with concrete anchors around the perimeter. Door leaves shall be ¼-inch aluminum diamond pattern plate, reinforced to support a minimum live load of 300 psf. Doors shall open to 90 degrees and automatically lock with an aluminum or stainless-steel hold open arm with release handle. Doors shall close flush with frame and be equipped with a flush drop handle for lifting and a non-corrosive locking bar. Hinges and all fastening hardware shall be stainless steel. Factory finish shall be mill finish aluminum. An alkali resistant bitumastic coating shall be applied to the frame exterior where it will contact concrete.

5.4.3.8.1 Fall Through Prevention System. Access openings shall be provided with a hinged safety grate system. Grate shall be aluminum construction, designed to support a minimum live load of 300 psf. Grate openings shall 4-inches by 6-inches to allow for visual inspection and limited accessibility for maintenance purposes when the grate is closed. Grate shall open to 90

degrees and automatically lock with an aluminum or stainless-steel hold open arm with release handle. Hinges and all fastening hardware shall be aluminum or stainless steel. Grate shall have an OSHA safety yellow finish to increase visual awareness of the safety hazard.

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~~ if equipped with full voltage starters, or one (1) RVSS/VFD is so equipped, 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 plug valve, and male cam-lock coupling shall be provided.

A. All pipe and fittings shall be four (4) inches in diameter and be the same material as the pump station piping.
B. The interface shall be constructed within a four-foot diameter, flat top manhole of required depth located external from but adjacent to the pump station.
C. A 30-inch by 30-inch aluminum access hatch and fall prevention system as described in Section 5.4.3.8 of these Standards shall be provided.

5.4.3.11 Not used.

5.4.3.12 General Electrical Requirements. All electrical equipment and wiring shall comply with the latest revision of the National Electrical Code (NEC). Particular attention shall be given to electrical equipment enclosed in places where gas may accumulate (hazardous areas). Submersible pumps are considered to be in a hazardous area and shall be rated for use in NEC Class 1, Division 1, Group C and D hazardous locations. This rating shall include pumps, removal systems, and controls.

5.4.3.12.1 Service and Distribution. Primary power to the station shall be 480 Volt, 3 Phase, and shall be provided by connection to a commercial utility service.

A. A service entrance disconnect switch acceptable to the utility provider shall be provided between the pump station and the utility. Service entrance equipment, when installed, shall be provided with maximum available fault current labeling in accordance with NEC guidelines. The field labeling shall include the date the fault current calculation was performed and be of sufficient durability to withstand the environment involved.
B. 3-phase power distribution and 1-phase branch circuit panel boards shall be provided as necessary.
C. A dry-type transformer for 120/240 volt single phase utility service and control system power shall be provided.
D. Equipment shall have a withstand and closing rating in RMS symmetrical amperes greater than the available fault current at the site and be provided with field or factory arc flash labeling in accordance with NEC guidelines.

E. All conduit, fittings, and conduit bodies shall be galvanized rigid steel, PVC coated externally, and urethane coated internally, equal to OCAL or Robroy and shall be installed below grade wherever possible. Conduit passing from a hazardous area into a nonhazardous area shall be provided with a sealing fitting which shall be located at the boundary in accordance with NEC.
F. Types, sizes, ratings, and electrical characteristics of service and distribution equipment and accessories shall be indicated on the Plans and Special Provisions.

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 a stationary engine generator rated at 125% of total combined load of all pumps and auxiliary loads.

5.4.3.13 Controls. Control system shall automatically operate the pumps in a pump down, lead/lag, common off, mode of operation. Control of pumps shall be by the use of a conductance relay level sensing system equal to Multitrode level sensor, three (3) meters in length, with a MTIC controller. The MTIC controller shall be used to indicate "PUMPS OFF," "LEAD PUMP ON," "LAG PUMP ON," and "HIGH LEVEL ALARM." The control panel shall include automatic pump alternation to equalize operating time on all duplex components and provisions to prevent simultaneous starting of pumps. Provisions shall be made to bypass the alternator in the event that either pump is out of service for maintenance. On larger sewage pumping station installations other control systems may be required. One (1) hand-off-auto switch and elapsed time meter shall be provided for each pump and be operable through control panel door. Elapsed time meters shall be calibrated in one-tenth (0.1) hour increments on all pumps.

5.4.3.14 Alarm and Monitoring Systems. Alarm systems shall be provided for all pumping stations. Equipment shall be a Mission Communications MyDro 150. All necessary equipment shall be provided to monitor and transmit the following conditions: 1. Pump No. 1 Running; 2. Pump No. 2 Running; 3. Pump No. 3 (if applicable); 4. High Wet Well Level; 5. Control Power Failure; 6. Transfer to Emergency Power Source; 7. Generator Running; 8. Common Alarm. Other alarm conditions may be required based upon pump station configuration and design such as grinder failure, dry well sump pump failure, or any cause of pump station malfunction.

5.4.3.14.1 Flow Metering. All sewage pumping stations shall be provided with flow metering. Flow meter shall be of the electromagnetic type and provide for transmitting of flow in full pipes. The flow tube shall be installed on the force main between two pipe flanges having the same nominal diameter as the flow meter end connections. A standard four-foot diameter manhole with removable flat top, and hinged frame and cover shall be installed around the force main and flow tube. The associated flow meter transmitter shall be installed in the control building housing the electrical switchgear. The transmitter shall contain all necessary circuitry to utilize the signal from the flow tube and display flow in gallons per minute and totalized flow in gallons. The transmitter shall include analog outputs to interface with the Alarm and Monitoring System specified in Section 5.4.3.14 above.

5.4.3.15 Emergency Power Supply. Provision of an emergency power supply for pumping stations shall be made and may be accomplished by connection of the station to at least two independent public utility sources, or by provision of in-place internal combustion engine equipment which will generate electrical energy unless a fail-safe gravity relief system can be incorporated into the wet well.

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 with an integral weather/sound enclosure and, if applicable, a sub-base fuel tank. An automatic transfer switch (Refer to Section 5.4.3.15.4 of these Design Standards) shall be provided to automatically switch to emergency power in the event of commercial power failure. The engine generator shall be sized for starting all pumps and all auxiliary loads, with an additional 25% overload capacity at site altitude within the following parameters:

A. Minimum genset load allowed, 30% of rated capacity.
B. Maximum genset load allowed, 75% of rated capacity.
C. Maximum allowable voltage dip, 25%.
D. Maximum allowable frequency dip, 10%.
E. Site temperature, 50°C.
F. Maximum allowable temperature rise, 125°C/Class H.
G. Emissions, EPA Stationary Emergency Application.

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 starting characteristics of the pump motors plus axillary loads.

5.4.3.15.2 Engine. The engine shall be multi-cylinder, 4-cycle, 1800 RPM, water-cooled, equipped to operate on natural gas for units rated up to and including 100 kw, natural gas or diesel at City's discretion for units rated 100 kw to 150 kw, diesel for units rated over 150 kw, and include the following features and accessories:

A. Electronic governor to provide automatic engine-generator set frequency regulation of 5% from steady state no load to steady state full load.
B. Unit-mounted closed loop radiator system to properly cool the engine when generator set is delivering full rated load with 50°C inlet air and provide protection to -20 degrees F. Guard rotating parts from accidental contact.
C. Low oil pressure, high water temperature, over-crank and automatic over-speed shutdown devices.
D. Electric starter capable of three complete cranking attempts without overheating.
E. Positive displacement, mechanical, full pressure, lubrication oil pump.

F. Full flow lubrication oil filters with replaceable spin-on cannister elements, dipstick oil level indicator and oil drain.
G. Replaceable dry element air cleaner for heavy duty application.
H. Engine mounted battery charging alternator with solid-state voltage regulator.

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 H with a ~~70~~ 120 degrees C maximum temperature rise. A completely wired and assembled generator control panel shall be furnished. It shall contain the following items:

A. A microprocessor-based controller with LCD display that will indicate voltage, current, and frequency.
B. 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, open transition or break before make switch. 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 connection to alarm system. It shall also have three voltage-sensitive relays with adjustable dropout of 70 to 80% and adjustable pickup ~~at~~ of 90 to 100%. Upon sensing of under-voltage condition, the generator startup and transfer sequence shall be initiated automatically. Provision shall also be made to manually initiate the sequence. A programmable exerciser timer shall be provided to set week, day, time, and duration of generator set exercise period.

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, and a microprocessor-based controller with an LCD display that will indicate oil pressure, coolant temperature, battery charging voltage, elapsed time meter, fail-to-start, line-power-on, and standby-power-on, protective shut-down, 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, and contact to signal protective shut-down and fail-to-start.

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 inside of weatherproof housing. The muffler system shall be residential type or better.

5.4.3.15.8 Engine Cooling Ventilation. 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 Not used.

5.4.4 Acceptance of Sewage Pumping Station.

5.4.4.1 Shop Drawings. Shop drawings shall be submitted on sewage pumping station, stand-by power source, and structures, and be approved prior to installation. One (1) electronic copy in portable document format (.pdf) and five (5) print copies are required. Two (2) print copies will be returned to the Contractor.

5.4.4.2 Testing. Prior to acceptance of sewage pumping ~~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.

Diesel fueled generator units to be run with site loads when NFPA testing results are supplied by the manufacturer. Gas units to be run with a 2-hour load bank, 1-hour at 80% load and 1-hour at 100% load to test gas supply.

5.4.4.3 As-Builts. Prior to acceptance of operation of sewage pumping ~~lift~~ station, generator units, and other related appurtenances by the City, one (1) electronic copy of "As-Builts" in AutoCAD and portable document format (.pdf) and three (3) sets of prints of "As-Builts" shall be submitted.

5.4.4.4 Operation and Maintenance Manuals. Four (4) complete sets plus an electronic copy in portable document format (.pdf) 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. Such tools and spare parts shall be provided in duplicate pairs.

5.5 FORCE MAINS

5.5.1 Velocity. Force main pipe diameter shall be sized to provide a minimum velocity of two (2) feet per second with one pump operating and a maximum velocity of eight (8) feet per second with multiple pumps operating.

5.5.2 Sewage Combination Air Valve. A single body sewage combination air valve equal to APCO Series 440-shall be placed at high points in the force main to automatically exhaust large quantities of air during pipeline filling at system startup, automatically allow air to re-enter the pipeline to protect the pipeline against negative pressures during draining, and automatically release small pockets of air from the pipeline while system is operating under pressure to prevent air locking. A standard four-foot diameter manhole with removable flat top, hinged frame and cover, and interior corrosion protection per Standard Drawing SAN-31 shall 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 in a manner that provides a smooth transition of flow and minimizes turbulence. Corrosion protection for the interior of the receiving manhole, upstream manhole, and two downstream manholes shall be provided. At the City's discretion, corrosion protection may also be required for additional upstream and downstream manholes, depending on the potential for sulfide generation as discussed in Section 5.6.2. Corrosion protection of new manholes shall be accomplished by the monolithic spray-application of a high-build, solvent-free epoxy resin coating system as specified in Chapter 4, Section 4.4. Surface preparation and product application and film thickness shall conform to the coating system manufacturer's recommendations. Rehabilitation of existing manholes to repair voids and restore structural integrity may be required prior to applying corrosion protection system. If required, rehabilitation of existing manholes shall be accomplished as specified in Chapter 4, Section 4.5.

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

5.5.4.1 Design Friction Losses. Friction losses through force mains shall be based on the Hazen-Williams formula or other acceptable method. A C-factor of 120 shall be used for computation of force main friction losses. When initially installed, force mains will have a significantly higher C-factor. Higher C-factors should only be considered in calculating maximum power requirements.

5.5.5 Thrust Blocks. Concrete thrust blocking shall be provided at all bends, tees, plugs, fittings or other significant changes in direction. Thrust block locations shall be noted on both plan and

profile views of the construction plans. Mechanical joint restraint devices should be considered in addition to concrete thrust blocks.

5.5.6 Force Main Pipe. All force main pipe shall be PVC conforming to AWWA C900 and have minimum pressure rating of 200 psi (DR21) HDPE pipe will be considered by the City only in special cases provided sufficient information is presented to justify its use. If approved, material and installation requirements shall be addressed in the Plans and Special Provisions for the project.

5.5.7 Trace Wire and Detectable Marking Tape. A trace wire shall be installed the entire length of the force main. Trace wire shall be accessible from the surface at intervals not to exceed 1000-feet of developed pipe length apart, at each end of roadway crossings, and adjacent to all air valve vaults. Terminal/access boxes shall be grade level, in-ground type specifically manufactured for such applications. Terminal boxes shall be installed flush with finished grade and centered in grade level reinforced concrete pad, minimum 18" by 18" by 6" thick, at locations approved by Engineer.

In addition to trace wire, a detectable marking tape specifically manufactured for marking and locating underground utilities shall be installed the entire length of the force main. Marking tape shall be installed directly over force main at a depth of 12- to 18-inches below finished grade.

5.5.8 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.

5.5.9 Steel Casing. Force mains designed to cross public streets must be encased in steel casing conforming to ASTM A53 with a minimum yield strength of 35,000 psi and a minimum wall thickness of 0.25-inch. Casing inside diameter shall be at least 4-inches greater than the outside diameter of the force main joints. Casing spacers shall be provided to permanently position the force main inside the casing and prevent any lateral or vertical movement. Force main joints inside casing shall be restrained to allow multiple pipe segments to be pushed or pulled without compressing or separating the assembled joints. Casing ends seals shall also be provided.

5.5.10 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, but not less than 150 psi. (Note: This must be shown on the Plans.)

5.6 ODOR CONTROL

5.6.1 General. The potential for sulfide and odor generation should be given due consideration when designing sewage pumping stations and associated force mains, especially where large sewer service areas and long force mains are involved. Ideally, pumping stations should be designed so as not to increase the total sulfide generation potential of the tributary collection

system. Sulfide generation potential increases with longer system residence times and studies have shown that significant sulfide generation can occur with detention time less than 2-hours.

Pumping stations may generally be classified as continuous or intermittent, depending primarily on size of the tributary sewer system and average and maximum flow rates. Of the two, the intermittent pumping stations have a much greater potential for sulfide generation than the continuous stations. It is for this reason that a maximum wet well design detention time of 30-minutes or less at design average flow is recommended for all but the larger pumping stations. Wet well detention times in larger pump stations equipped with variable speed pumps are generally sufficiently short to avoid sulfide generation.

5.6.2 Sulfide Control. All pumping station designs should include an evaluation of the influent wastewater conditions, and of the impact of wet well storage and force main sulfide generation. Alternatives for sulfide and odor control in pumping stations and force mains include: 1) wet well aeration; 2) chemical addition; 3) collection and treatment of H_2S contaminated air; 4) air bypassing to a downstream section of sewer; and 5) injection of air or oxygen upstream in the force main. Guidance for the design of each of these alternatives can be found in the EPA Design Manual *Odor and Corrosion Control in Sanitary Sewerage Systems and Treatment Plants*, EPA/625/1-85/018.

6 STORM SEWER AND DRAINAGE DESIGN

For Chapter 6 Storm Sewer and Drainage Design standards please reference the Flood Control and Water Quality Protection 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 Control and Water Quality Protection 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	61	79
Collector	44	64
Local Non-Residential	19	37
Local Residential	12	26
Alleys	7	17

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.

8.1.3.14 Longitudinal Joints. Longitudinal joints shall be placed as shown on the Standard Drawings.

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%).