DESIGN CRITERIA FOR
STREET LIGHTING

A. SCOPE. These criteria shall be adhered to for the design of all street lighting systems to be installed in the public street right-of-way. Continuous street lighting systems shall consist of one or more service enclosures, distribution systems, poles, luminaires, and other appurtenances required to provide a complete, operable lighting system. The City Engineer shall be responsible for determining the scope of a street lighting system.

B. LOCAL STREET LIGHTING. City policy is not to continuously light local streets, therefore lighting along local streets does not provide specific maintained light averages and uniformity ratios. The purpose of local street lighting is to provide enough light on the street to enhance the safety of the street users but to avoid over lighting the area. All streetlights on local streets will be installed in conformance with the following basic guidelines.

At Intersections:
In order to provide lighting within the intersection area of two local streets, a light pole will be installed on one corner of an intersection or opposite the intersection in the case of a T-intersection.

Within Cul-de-Sac Bulbs:
A light pole will be installed within the cul-de-sac bulb when the cul-de-sac street is longer than 200 feet measured from the intersection of the intersecting streets to the center of the cul-de-sac bulb.

Mid-block Streetlights:
A minimum number of mid-block streetlights will be installed in order to achieve a desired pole spacing of approximately 250 feet. The maximum spacing between lights should not exceed 300 feet and the minimum spacing between lights should not be less than 200 feet unless otherwise approved by the City Engineer. Lights should desirably be located on or near a property line and not in front of residences, if avoidable.

At this time, lighting on local streets is installed and maintained by the electrical utility company. For all new developments, the developer shall indicate the location of streetlights on the roadway plans for all local streets. The City Engineer will review the location of streetlights and authorize the electrical utility company to install the streetlights when the street is constructed and accepted for maintenance.

C. CONTINUOUS LIGHTING DESIGN. These criteria are established to provide uniform procedures to aid the Design Engineer in preparing improvement plans. These criteria are not to be a rigid set of rules that would restrict the Design Engineer from utilizing creative or original design; however these criteria may be modified only with prior authorization by the City Engineer.

The ***AASHTO Roadway Lighting Design Guide*** permits either the illuminance method or the luminance method to be used in the design of highway lighting. The luminance method requires a complex design process and knowledge of the reflective characteristics of the pavement surface used. These reflective characteristics change as the pavement ages and with variations in weather conditions. It is for these reasons that the luminance method is not allowed by the City.

Photometric analysis shall be utilized to calculate the theoretical spacing of street lights to meet the illumination criteria based on the street classification. The City Engineer should be consulted to determine the appropriate street classification. The minimum illumination criteria should be as shown in the table on the following page.

Street Classification	Minimum Maintained Average Illumination	Average-to-Minimum Uniformity Ratio
Arterial	1.3 foot-candles	3:1
Commercial Collector	0.9 foot-candles	4:1
Residential Collector	0.6 foot-candles	4:1

The street pavement surface is assumed to be the R3 reflective classification. The lighting loss factor shall be 1.0 for all photometric analysis. Only luminaires listed in the City's Approved Materials List shall be utilized for photometric analysis.

D. PLACEMENT OF STREET LIGHT POLES. The actual spacing of street light poles should be the possible spacing nearest to the calculated theoretical spacing. At locations where additional lighting may be beneficial, such as around curves, at intersections, and at crosswalks, pole spacing may be reduced to increase lighting levels.

Street light poles shall have a minimum setback of three feet, measured from the back of curb to the center of the pole foundation. The minimum setback for a non-curbed street shall be six feet, measured from the edge of pavement to the center of the pole foundation. Poles may be located in medians where the minimum setback requirements can be satisfied. In medians, poles shall be installed as close as possible to the center of the median. All poles in medians shall be a minimum of 15 feet behind the median nose.

Poles located at the intersection of residential streets should desirably be placed so the light pole can be used to mount stop and street name signs. That means the pole should be installed as near to the location where a vehicle should stop while maintaining the minimum setback of three feet from the back of curb.

All poles installed in residential areas should ideally be located on or near property lines whenever possible. In the case of larger lots, poles cannot always be located on the property line. In these cases, in order not to exceed the maximum desired pole spacing, poles can be located within the lot. The designer should take care not to locate the pole in front of large windows of houses. Any pole located near a residential drive entrance should be located a minimum of five feet from the edge of the drive or concrete wing.

The Design Engineer should also coordinate the location of all poles with existing trees, such that the fixture does not extend into the tree canopy or such that the tree canopy does not block the light output from the fixture.

Street light poles should be located to have a minimum clearance of 10 feet from all overhead electrical utilities. Specific clearance requirements shall be determined by the utility company and/or ***National Electric Safety Code***. A minimum clearance of three feet shall be maintained from any non-electric lines such as cable TV lines, aerial fiber lines, etc. The Design Engineer shall be responsible to determine if adequate clearance can be achieved and make adjustments to the pole locations or coordinate utility relocation if necessary.

E. STREET LIGHT POLES. Street light pole types, differentiated by mounting height and bracket arm length, are illustrated in the Standard Drawings. Equipment to be utilized should be selected based on the following criteria.

Luminaires should be installed at a maximum mounting height of 40 feet above the roadway. Poles mounted on structures, such as bridges and retaining walls, may require special pole lengths as not to exceed the maximum mounting height.

Bracket arms should be selected to position the luminaire over the traveled way for greatest utilization of available light. The bracket arms should be oriented 90-degrees, or perpendicular, to the traveled way. Bracket arm lengths should be selected in order to position the luminaires in a relatively straight line when looking down the roadway.

Decorative street light poles are not allowed unless approved by the City Engineer.

F. STREET LIGHT POLE FOUNDATIONS Screw-in anchor foundations are assumed to be used for all poles wherever possible. If a screw-in anchor cannot be installed for any reason, such as encountering rock, then a concrete foundation shall be installed. Screw-in anchor foundations are not to be installed in soils that have been disturbed or filled to a depth of 3 feet or more.

G. LUMINAIRES. In general cobrahead style LED luminaires are rated as Class A through Class E depending on their ability to light a particular type of roadway and cross section. Recent advances in LED technology allow for fixtures with greater lumen output, which are rated as Class Z. Typically, the lowest class of LED luminaire should be used in the design that satisfies the given lighting criteria. An approximate comparison between the different classes of LED luminaires and high pressure sodium (HPS) luminaires is as follows:

Class Z LED – greater than 400 W HPS
Class A LED – approximately equivalent to a 400W HPS
Class B LED – approximately equivalent to a 310W HPS
Class C LED – approximately equivalent to a 250W HPS
Class D LED – approximately equivalent to a 150W HPS
Class E LED – approximately equivalent to a 100W HPS

The City uses only two LED luminaire models with field adjustable light outputs to achieve the different classes of lumen output. The Design Engineer should refer to the City's Approved Products List for the models of luminaires, light loss factors, and the photometric files that should be used for photometric analysis.

H. CONDUIT. The distribution system shall be underground in 2-inch conduit. Conduit for street lighting systems shall be either Schedule 40 polyvinyl chloride (PVC) conduit or SDR 11 high density polyethylene (HDPE) conduit. Cable-in-duct may be installed for projects in mostly unpaved areas. If conduit is to be installed on a structure, rigid metal conduit (RMC) conduit should be used per the requirements of the Missouri Department of Transportation. In new concrete structures, PVC conduits can be embedded when structures are constructed.

Except where it crosses under a street, the conduit shall be behind the back of curb or outside the edge of pavement. The conduit should be installed at a constant offset from the back of curb or edge of pavement preferably at the same distance as the pole setback, unless a common trench is being used. The minimum setback from the street to the center of the conduit should be the same as that specified for street light poles except in medians, where conduit setback may be closer to the back of curb to avoid landscaping. The setbacks may have to be adjusted in places to avoid storm sewers, utility conflicts, or other obstructions.

In unpaved areas, conduit can be trenched or plowed. Conduit shall be bored under all sidewalks, drives, and streets unless otherwise approved by the City Engineer. Boring under streets shall be perpendicular to the roadway or the shortest possible crossing distance.

The length of conduit is calculated by adding the center to center distances between equipment. All of the center to center distances should be subtotaled and multiplied by 102% to allow for bending of conduit to avoid obstructions. The method of conduit installation is not quantified.

I. JUNCTION AND PULL BOXES. Junction or pull boxes shall be installed at each location where splices in the distribution cable are required outside the pole base or where 90-degree bends in conduit runs are required. The distance between boxes and/or street light poles shall not exceed 300 feet to facilitate the pulling of cable. Boxes must be installed at least 10 feet away from street light poles to allow for conduit sweeps. The minimum setback from the street to the center of boxes should be the same as specified for street light poles. The installation of boxes in streets, driveways and curb ramps is unacceptable. In addition, the City prefers that boxes not be installed in the sidewalk. Boxes should be located on level ground, clear of ditches.

Type 1 junction boxes shall be used if one or two conduits enter/exit the box. Type 2 junction boxes shall be used where three or four conduits enter/exit the box. A Class 1 pull box shall be located adjacent to each service enclosure, or where five or more conduits enter/exit the box.

J. SERVICE ENCLOSURE. The Design Engineer shall coordinate and verify the location of the service enclosure with the electric utility company to ensure availability of service. Secondary service for street lighting shall be three-wire 120/240 Volt single phase. Service enclosures are typically located behind the sidewalk, or at least 10 feet from the back of the curb (or edge of pavement where there is no curb). Service enclosures should be generally located on level ground, clear of ditches, and clear of sight lines for right-turning traffic at intersections. Each service enclosure shall contain a photoelectric cell, to be oriented to the north or east. Four-circuit service enclosures are typically used for street lighting systems, unless otherwise approved by the City Engineer.

A 3-inch Schedule 40 PVC conduit with power cables shall be installed from the service enclosure to the foundation of the secondary service point (utility pole, secondary pedestal, or pad-mount transformer) as designated by the electrical utility company. The conduit should be installed in a straight horizontal line in accordance with the Standard Drawings, and should be 100 feet or less in length. Junction or pull boxes are not permitted in the conduit run between the service enclosure and secondary service point unless authorized by the electrical utility company. Power cables shall be three #2 cables. The electrical utility company will supply the meter and connect the power cables to the transformer.

K. CIRCUITS. All street lighting circuits shall be two-wire 240 volt (hot to hot) system with a ground wire. Distribution cable shall be sized so that the voltage drop does not exceed 5% at any point in the system. The Design Engineer is required to submit voltage drop calculations for verification. Distribution cables shall be no larger than #4 and no smaller than #8. Voltage drop calculations shall be prepared using the full input wattage of the luminaire, even if the light output is designed to be adjusted in the field.

Each street lighting circuit shall be contained in a separate conduit, except for the conduit raceway between a service enclosure and the adjacent class 1 pull box. For that raceway, two conduits will be required. The distribution cable for each of the lighting circuits shall be routed

through one of these two conduits into the class 1 pull box, and then routed to the first pole for each circuit through separate conduits.

Splices in the distribution cable should be minimized. Circuits shall not be spliced between the service enclosure and the first street light pole on each circuit. Splices in distribution cable should be made using insulated multi-cable connector kits. Splicing of distribution cable is only allowed in pole bases, pull boxes, or junction boxes.

The length of distribution cable is calculated by adding the center to center distances between all equipment on a circuit. The length of all cable should be subtotaled and multiplied by 102% to allow for bending. Five feet of slack should be added at each light pole base or power supply. Slack should also be added for junction and pull boxes; two feet at each Type 1 junction box, three feet at each Type 2 junction box, and six feet at each Class 1 pull box.

L. POLE WIRING. Pole and bracket cable consists of a 3-conductor cable run inside the street light pole. Poles with dual luminaries will require two 3-conductor pole and bracket cables. The distribution cables are spliced to the pole and bracket conductors in the pole base using multiple tap connectors. Break-away disconnects are also installed on each pole and bracket conductor in the pole base. Fused disconnects should be used for each of the phase conductors, and a non-fused disconnect should be used for the ground conductor as shown in the Standard Drawings.

The length of 3-conductor pole and bracket cable at each street light pole is calculated by adding the nominal pole height, the length of the bracket arm, and five feet of slack. This quantity is multiplied by the number of luminaires on the pole.

M. GROUNDING. All street light poles shall be bonded together to form a continuous system. Ground rod shall be installed adjacent to each concrete street light pole foundation and each service enclosure. Ground rods are not required to be installed with to screw-in anchor foundations. The grounding conductor shall be bonded to each ground rod.

N. POLE NUMBERING. Street light poles shall be numbered using the service enclosure identification number followed by the circuit number and pole number. For example the first pole on circuit number 1, from service enclosure number 2F03 should be labeled as 2F03-1-1. The second pole on the circuit shall be labeled 2F03-1-2.

PLAN REQUIREMENTS

The street lighting plans shall include all information necessary to build and check the design of a street lighting system. Street lighting plans shall meet all public improvement project plan preparation requirements for the City of Liberty in addition to the requirements listed in this section.

Street Lighting plans shall consist of the following sheets:

- Title Sheet
- General Notes and Quantities Sheet
- Street Lighting Plan Sheet(s)
- Wiring Diagram
- Standard Detail Sheets

Title Sheet: Title sheet is only required for stand-alone lighting projects. If street lighting plans are part of a larger plan set, a title sheet is not necessary. The title sheet shall meet the City's plan requirements for public improvement projects.

General Notes and Quantities Sheet: This sheet should contain the following:

A. List of general notes to the Contractor
B. Any project specific notes
C. Legend of symbols that apply to all sheets
D. Lighting design calculations and illumination criteria
E. Recapitulation of quantities table

Street Lighting Plan Sheet(s): The plan sheet(s) shall include the following information:

A. One or more plan sheets adequately showing the street lighting system in relation to the streets and adjacent properties, with a north arrow, and a bar scale at a minimum scale of 1 inch equals 50 feet.
B. All existing and proposed utilities such as power, gas, water, telephone, cable, sanitary sewer, storm sewer, and other items shall be accurately shown according to the best available information in the records of the owner of the facility, or field location, and shall be identified as to type, size, material, etc., as may be applicable. Existing utilities should be shown in gray.
C. All existing and known proposed improvements within 50 feet each side of the right-of-way and 100 feet beyond the project limits shall be shown at their proper locations unless otherwise approved or required by the City Engineer. These improvements shall include items such as street pavement, curbs and gutters, sidewalks and driveways, storm and sanitary sewers, water mains and fire hydrants, utility poles and pedestals, trees and shrubs, fences and walls, buildings, and similar items, and shall be identified as to type, size, material, etc., as may be applicable. Irrelevant items may be omitted for new developments. Existing items should be shown in gray. New non-lighting items may be shown with a thin black line. Future non-lighting items may be shown with a thin dashed line.
D. Typically, street lighting equipment does not need to be identified by station and offset unless stationing is available. If the street lighting is part of an improvement project for which stationing and controls have been developed, street centerline stations should be shown and marked at 100-foot intervals for consistency between the signal and improvement plans. If station and offset are not indicated, the locations of proposed street lighting equipment should be referenced from existing features that appear on the base plans, such as the back of curb, edge of pavement, utility poles, etc.
E. Each item to be constructed or installed for the project should be legibly noted. Each power supply should be labeled with the identification number assigned by the City Engineer. Street light poles should also be labeled with the power supply identification number, circuit number and pole number as previously described.
F. There should be a table listing the pole number, station, offset, and bracket arm length, and luminaire type for all proposed poles. There should also be a table listing the box number, station, offset and type of box for all proposed junction and pull boxes. All proposed equipment shall be listed in the order in which it is located in the plans.

Wiring Diagram: This sheet should include an overall schematic of the street lighting circuitry from each service enclosure. The center to center distance between street light equipment should be indicated on the diagram. A summary table for each circuit should also be included on this sheet indicating the conductor size, circuit length, input amperage, percent voltage drop, circuit assignment at the service enclosure, and branch circuit breaker trip rating.