DC10 – DESIGN CRITERIA FOR STREET LIGHTING CONSTRUCTION

DC10-001 GENERAL. Proposed street lighting construction in the City of Gardner shall conform to the City of Gardner *Technical Specifications and Design Criteria for Public Improvement Projects* and all applicable Standard Details. Plans shall be submitted electronically to the Infrastructure Department, Engineering Division, for approval and shall include all required information as outlined in this Section. Street Light plans shall be submitted concurrently with the Street plans as a standalone plan set bearing the same City of Gardner project number.

DC10-002 CATEGORIES OF STREETS AND PROCEDURES. For all street classifications, street lights shall be installed in accordance with Chapter 17.04.010 of the City of Gardner Municipal Code, unless otherwise approved by the City Engineer.

DC10-003 DESIGN PROCESS.

The illumination design process involves the selection of the proper lighting equipment and the establishment of the geometry of the system in order to provide the most effective lighting system. The major steps of the design process are outlined as follows:

- **Existing Conditions**-Determination of roadway facility and land use area classifications.

- **Selection of Illumination Level** - The recommended average intensity of horizontal illumination shall be determined based upon the classifications of roadway facility and area type.

- **System Characterization** - Detailed calculations using selected light source types and sizes and luminaire mounting height and spacing locations are utilized in order to determine the average intensity of horizontal illumination. Based upon the selected equipment and geometrics, an isocandle diagram or computer program equivalent is utilized to determine the minimum illumination level. The uniformity of illumination is checked by comparing the ratio of average maintained illumination to minimum maintained illumination, commonly referred to as the uniformity ratio, with the recommended criteria in order to determine optimal effectiveness of lighting system.

DC10-004 DESIGN CONDITIONS.

The number of luminaires shall be minimized and shall be located behind sidewalks, unless otherwise approved by the City Engineer. Breakaway pole bases are required for Collector, Industrial/Service and Arterial Street installations.

Determination of light source size, type, mounting height and spacing shall at least conform to the requirements outlined below based upon the required illuminance levels when the luminaires are at their lowest output. This condition occurs just prior to lamp replacement and luminaire washing. Therefore, formulas calculating average illuminance shall include light loss factors relating lamp lumen depreciation and luminaire dirt depreciation.

Local Streets:

- Luminaires will be located at intersections of local residential streets, equally spaced along cul-de-sacs longer than 200 feet, at changes of alignment of 60° or more which are 200 feet or more from an intersection, and/or a minimum number of mid-block lights such that the spacing between lights is approximately 200 ft.
- LED luminaires
- Post-top luminaries in accordance with the City of Gardner Approved Materials List
- Spun aluminum poles for 14' mounting heights

Collector and Industrial/Service Streets:

- LED luminaires
- In conformance with the City of Gardner Approved Materials List
- 30' round, spun aluminum poles
- The collector standard streetlights shall be used at the intersection of collector and residential streets.

Arterial Streets:

- LED Luminaires
- In accordance with the City of Gardner Approved Materials List
- 40' round, spun aluminum poles, black in color

DC10-005 PEDESTRIAN CONFLICT AREA CLASSIFICATION.

The classification of urbanized areas shall be generally defined as follows:

- **High.** High pedestrian use areas are generally densely developed business districts, which attract a heavy volume of nighttime vehicular and/or pedestrian traffic.
- **Medium.** Medium pedestrian use areas are characterized by multi-family residential and commercial land uses, such as libraries, recreation centers and neighborhood retail buildings.
- **Low.** Low pedestrian use areas are generally single family and duplex residential developments with minimal nighttime pedestrian traffic.

DC10-006 ROADWAY FUNCTIONAL CLASSIFICATION.

The functional classification of roadways is defined in American National Standards Institute (ANSI) Illuminating Engineering Society (IES) RP-8.

DC10-007 RECOMMENDED AVERAGE MAINTAINED ILLUMINATION.

The average illumination design criteria for roadways and intersections are outlined in Table DC10-007-1 and DC10-007-2, respectively.

Table DC10-007-1 *-Illuminance Requirements for Roadways*

Roadway Functional Classification	Average Maintained Illumination at Pavement, fc			Illuminance Ratio[1]
	Pedestrian Use Classification			
	High	Medium	Low	
Freeway	0.6	0.6	0.6	3
Expressway	1.4	1.2	0.9	3.0
Arterial	1.7	1.3	0.9	3.0
Collector and Industrial/Service	1.2	0.9	0.6	4.0
Local	0.9	0.7	0.6	6.0
Alley	0.6	0.4	0.4	6.0

[1] Illumination Ratio equals Average Illuminance divided by Minimum Illuminance

Table DC10-007-2 *-Illuminance Requirements for Intersections*

Intersection Type	Average Maintained Illumination at Pavement, fc			Uniformity Ratio[1]
	Pedestrian Use Classification			
	High	Medium	Low	
Arterial/Arterial	3.4	2.6	1.8	3.0
Arterial/Collector	2.9	2.2	1.5	3.0
Arterial/Local	2.6	2.0	1.3	3.0
Collector/Collector	2.4	1.8	1.2	4.0
Collector/Local	2.1	1.6	1.0	4.0
Local/Local	1.8	1.4	0.8	6.0

[1] Illumination Ratio equals Average Illuminance divided by Minimum Illuminance

DC10-008 <u>DESIGN CALCULATIONS</u>.

All calculations shall conform to the standard practice of the Illuminating Engineering Society of North America and shall be included with the plan submittal. The required calculations are summarized below.

- **Spacing** - The spacing between the luminaires is the longitudinal distance if spaced in staggered or one-sided arrangement. This distance is one-half the longitudinal distance if luminaires are arranged in opposite spacing.
- **Light Loss** - The light loss factor represents the luminaire conditions at their lowest output level. The total factor is based upon the contribution of individual light loss factors such as lamp lumen depreciation, luminaire dirt depreciation, ambient temperature, in-service voltage, ballast, lumen component depreciation, physical surroundings and burnouts. The light loss factor can be determined by tables from the equipment manufacturer for the given luminaire type.
- **Coefficient of Utilization** - The coefficient of utilization is equal to the total of street side and house side coefficients of utilization as determined from the equipment manufacturer coefficient of utilization curves for the given luminaire type, placement and mounting height.
- **Minimum Illumination** - Minimum illumination is determined from the isofootcandle diagram or computer program equivalent from the equipment manufacturer for the given luminaire type, placement and mounting height.

- **Uniformity Ratio** – The uniformity ratio shall not exceed 4:1 and preferably not exceed 3:1, except on residential streets where 6:1 may be acceptable.
- **Cutoff** - The control of candlepower distribution shall be a true 90° cutoff.

DC10-009 <u>ELECTRICAL SYSTEM</u>.

The electrical system shall comply with the American National Standard Practice for Roadway Lighting, the National Electrical Code (NEC) and the National Electrical Safety Code (NESC) as summarized below:

- At signalized intersections, a 200- amp switch load street light cabinet shall be installed on the same concrete pad as the traffic signal cabinet, in accordance with the City of Gardner Approved Materials List and applicable Standard Details.

- Conduits and junction boxes for streetlight and traffic signals shall remain separate except for streetlights located on traffic signal poles.

- Wiring for streetlights shall be copper. Aluminum wire will not be permitted.