



# Town of Oakville

## Street Lighting Standard

**Version 1.2**

**September 2018**

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## A. Preamble

The purpose of the Oakville Street Lighting Standard is to establish municipal road corridor lighting levels, control the energy consumption and light pollution of street lighting, including all local streets, adjacent bikeways and pedestrian ways, as defined by ANSI/IES RP-8-14 Standard Practice for Roadway and Street Lighting and the Transportation Association of Canada TAC 8 Guide for design of roadway lighting, in a manner consistent with the Oakville Municipal Outdoor Lighting Standard.

## B. Street Lighting Definitions

### I. Street lighting

Lighting provided for municipal streets where pedestrians and cyclists are generally present. The primary purpose of street lighting is to help the motorist identify obstacles, provide adequate visibility of pedestrians and cyclists, and assist in visual search tasks, both on and adjacent to the roadway.

### II. Cobra Head Street Lighting Luminaire

In general, streets may be lighted by means of “Cobra head” style luminaires designed specifically for street lighting applications and having the following design characteristics:

- Designed to mount on a pole using a horizontal bracket arm;
- An aluminum top housing containing the light source, associated control gear and mounting mechanism
- An optical aperture that is either open or enclosed with a flat lens
- Mounted in a fixed position;
- Provided with a photometric file tested to IES LM-79-08 (LED Light Sources) using type C photometry per IES LM-75-01.

### III. Decorative Street Lighting Luminaire

A “Traditional Coachlight” style luminaire intended for lighting streets that serve a decorative function in addition to providing optical performance that delivers street lighting appropriate for the street and pedestrian usage. It will have a coachlight appearance, and will have the following design characteristics:

- Designed to mount on a pole using a bracket arm or vertical tenon;

- b. An aluminum top housing containing the light source, associated control gear and mounting mechanism, and translucent side panels;
- c. An optical aperture that is either open or enclosed with a flat lens;
- d. Mounted in a fixed position;
- e. Provided with a photometric file tested to IES LM-31-95 (HID Light Sources) or IES LM-79-08 (LED Light Sources) using type C photometry per IES LM-75-01.

## C. Scope

All street lighting not governed by regulations of federal, provincial or other super ceding jurisdiction.

**EXCEPTION:** lighting systems mounted less than 3.15m above street level and having less than 1000 initial lumens each.

## D. Master Street Lighting Plan

### I. New Development

All new development in The Town of Oakville will adhere to the Oakville Street Lighting Standard. Streetlights may also be upgraded through road improvements as required by private development undertakings.

### II. Lighting Technology

Specifications shall include but are not limited to:

- a. **Light Source;** Light Emitting Diode (LED)
- b. **Mercury Content:** LED lighting luminaires shall contain no mercury
- c. **Correlated Colour Temperature (CCT);** 4000K  $\pm$  250K
- d. **Energy Consumption:** Luminaires must be chosen to minimize energy consumption

### III. Lighting Design Standards

All street lighting designs will meet the uniformity ratios, glare control requirements and the recommended average illuminance/luminance recommendations of the 2006 Transportation Association of Canada Guide for Design of Roadway Lighting and ANSI/IESNA–RP-8-14 Recommended Practice for Roadway Lighting.

#### a. Straight Roadways, Streets and Sidewalks

Luminance is the recommended method for roadway lighting calculations. The luminance levels, uniformity and veiling luminance ratios to be used in the Town of Oakville are provided in Table 1 below. Illuminance is the recommended method for sidewalk lighting calculations. The illuminance levels for sidewalks to be used in The Town of Oakville are also provided in Table 1 below.

**Table 1: IES RP-8-14 Recommended Practice for Straight Streets**

| Roadway Classification | Pedestrian Conflict | Avg. Luminance Lavg (cd/m <sup>2</sup> ) | Avg. Uniformity Ratio (Lavg/Lmin) | Max. Uniformity Ratio (Lmax/Lmin) | Max. Veiling Luminance Ratio (Lvmax/Lavg) | Sidewalk Average Illuminance Eavg (lux) |
|------------------------|---------------------|------------------------------------------|-----------------------------------|-----------------------------------|-------------------------------------------|-----------------------------------------|
| Local                  | Low                 | 0.3                                      | 6.0                               | 10.0                              | 0.4                                       | 3.0                                     |
|                        | Medium              | 0.5                                      | 6.0                               | 10.0                              | 0.4                                       | 5.0                                     |
|                        | High                | 0.6                                      | 6.0                               | 10.0                              | 0.4                                       | 10.0                                    |
| Collector              | Low                 | 0.4                                      | 4.0                               | 8.0                               | 0.4                                       | 3.0                                     |
|                        | Medium              | 0.6                                      | 3.5                               | 6.0                               | 0.4                                       | 5.0                                     |
|                        | High                | 0.8                                      | 3.0                               | 5.0                               | 0.4                                       | 10.0                                    |
| Arterial               | Low                 | 0.6                                      | 3.5                               | 6.0                               | 0.3                                       | 3.0                                     |
|                        | Medium              | 0.9                                      | 3.0                               | 5.0                               | 0.3                                       | 5.0                                     |
|                        | High                | 1.2                                      | 3.0                               | 5.0                               | 0.3                                       | 10.0                                    |

(This table is extracted from IESNA RP-08-14)

Where:

Lavg - minimum maintained average pavement luminance

Lmin - minimum pavement luminance

Lvmax - maximum veiling luminance (a measure of the glare produced by the lighting system)

Sidewalk Average Illuminance - minimum maintained average horizontal illuminance (lux)

#### b. Intersections

The primary method of design for intersections is illuminance. The values included in Table 2 are the recommended minimum average maintained illuminance levels for fully lighted intersections based on road classification and pedestrian volumes. The values for full intersection lighting represent the sum of the recommended values for the intersecting streets.

**Table 2: IES Recommended Practice for Intersections**

| Street Functional Classification | Average Maintained Illumination at Pavement by Pedestrian Area Classification in [Lux/FC] |        |         | Uniformity Ratio Eavg/Emin |
|----------------------------------|-------------------------------------------------------------------------------------------|--------|---------|----------------------------|
|                                  | High                                                                                      | Medium | Low     |                            |
| Arterial/Arterial                | 34/3.4                                                                                    | 26/2.6 | 18/1.8  | 3.0                        |
| Arterial/Collector               | 29/2.9                                                                                    | 22/2.2 | 15/1.5  | 3.0                        |
| Arterial/Local                   | 26/2.6                                                                                    | 20/2.0 | 13/1.3  | 3.0                        |
| Collector/Collector              | 24/2.4                                                                                    | 18/1.8 | 12/1.2  | 4.0                        |
| Collector/Local                  | 21/2.1                                                                                    | 16/1.6 | 10/1.0  | 4.0                        |
| Local/Local                      | 18/1.8                                                                                    | 14/1.4 | 8.0/0.8 | 6.0                        |

(This table is extracted from IESNA RP-08-14)

c. **Curves and Cul-de-Sacs**

i. Cul-de-sac (Dead-end Street)

Due to the irregular shape and terminal nature of cul-de-sacs, it is impractical to apply the luminance design method to those roadway areas. Illuminance is therefore the required method of design for a cul-de-sac. The area of a cul-de-sac begins at the start of the cul-de-sac curb return radius. The requirements for cul-de-sac lighting are determined by targeting the illuminance values for the approach roadway. Where the approach street has been designed using the luminance method, the equivalent illuminance can be calculated using the ratio of  $1 \text{ cd/m}^2 = 15 \text{ lux}$  for an R3 pavement or  $1 \text{ cd/m}^2 = 10 \text{ lux}$  for an R1 pavement.

ii. Curves

Lighting systems along streets with gradual curves (radius greater than or equal to 600m) shall be designed using the luminance method and shall have luminaires positioned so that they are aimed 90 degrees to the tangent of the curve. This assures a balanced light distribution on the pavement. Luminaires may require closer spacing in order to achieve the required lighting levels/uniformities. The design criteria shall be according to the road classification and pedestrian conflict level.

#### **IV. General Specification**

This specification is for the evaluation and purchase of Light Emitting Diode (LED) roadway lighting luminaires for mounting on pole tops or mast arms attached to power utility poles or independent street-lighting concrete, wood or aluminum poles. Applications shall include municipal standard local, collector, and arterial roadways and intersections. Luminaires must meet the general requirements of this specification.

a. **Reference Publications**

The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by their basic designation only.

**American National Standards Institute (ANSI)**

- i. ANSI C136.2-2004 (R2009), American National Standard for Roadway and Area Lighting Equipment—Luminaire Voltage Classification
- ii. ANSI C136.3-2005, American National Standard for Roadway and Area Lighting Equipment—Luminaire Attachments
- iii. ANSI standard C136.41, American National Standard for Roadway and Area Lighting Equipment—Dimming Control Between an External Locking Type Photocontrol and Ballast or Driver.

- iv. ANSI C136.25-2009, American National Standard for Roadway and Area Lighting Equipment – Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures
- v. ANSI C136.31-2001, American National Standard for Roadway Lighting Equipment – Luminaire Vibration

**American Society for Testing and Materials International (ASTM)**

- vi. ASTM B117-97 – Standard Practice for Operating Salt Spray (Fog) Apparatus

**Illuminating Engineering Society of North America (IESNA)**

- vii. LM-79-08, IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products
- viii. LM-80-08, IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources
- ix. LM-82-12, IESNA approved Method for the Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a function of Temperature
- x. RP-8-14, ANSI / IESNA American National Standard Practice for Roadway Lighting
- xi. RP-16-05 and addenda, “Nomenclature and Definitions for Illuminating Engineering”
- xii. TM-15-11, “Luminaire Classification System for Outdoor Luminaires”
- xiii. TM-21-11, « Projecting Long Term Lumen Maintenance of LED Light Sources »

**Institute of Electrical and Electronic Engineers (IEEE)**

- xiv. ANSI/IEEE C62.41.2-2002 – IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits
- xv. ANSI/IEEE C62.45-2002 – IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (100 V or less) AC Power Circuits.

**National Electrical Manufacturers Association (NEMA)**

- xvi. ANSI/NEMA/ANSI C78.377-2008 – American National Standard for the Chromaticity of Solid State Lighting Products

**Underwriters Laboratories (UL)**

- xvii. UL 1449, Surge Protective Devices
- xviii. UL 1598, Luminaires

**Canadian Standards Association**

- xix. CSA Standard C22.2 No. 250.0-08, Luminaires (Tri-national standard with UL-1598 and NMX-J-307/1-ANCE)

**b. Cobra-Head Style LED Luminaire Specification**

**i. Housing**

- (a) The housing shall be of rugged, highly corrosion resistant, light weight die-cast aluminum alloy.
- (b) The luminaire housing shall be painted with a durable polyester powder coat. Castings shall be pre-treated using a 5-stage iron phosphate system to assure adhesion. Colour is to be neutral grey.
- (c) Luminaire components and applied finishes shall pass the 1000 hour salt test per ASTM B117 standard.
- (d) luminaires shall be horizontal mast arm mountable and allow for continuous adjustment in the vertical plane of + / - 3 deg. A hex head clamping assembly shall provide secure attachment of the luminaire to the supporting mast arm. The assembly shall accommodate 1.25 to 2 inch pipe size mast arms.
- (e) Where small metal machine screw fastening hardware is utilized in the luminaire assembly, it shall be of a material that is corrosion resistant and compatible with the housing material. The hardware will have a Robertson or hex head drive. Flat or Philips head drives are not acceptable.
- (f) Internal system components, clamping assembly and terminal block shall be accessible without the use of tools. Access doors shall be latched, swing down to the open position and be mechanically secured to the main housing. Drivers and LED array modules must be mounted internally, be modularly replaceable, and be easily accessible for replacement.
- (g) The luminaire shall be CSA or cUL listed for wet locations. The LED optical module shall be sealed and tested to IEC spec 529 to meet a rating of IP66 for particulate and moisture ingress. Power supply/driver unit shall also be rated IEC IP66. The housing shall contain measures that prevent the entry of birds.
- (h) The outer exposed surface of the optical system shall be designed so that there will be no adhesion of snow and minimal dirt collection that will block normal egress of light. The system exterior shall also be easy to clean by hand. All light transmitting materials must be high UV stabilized or glass so as not to discolour due to sunlight or high luminous flux transmission over its expected operational life.
- (i) The luminaire and all subcomponents are to be free of designated hazardous substances that would otherwise prevent it from being disposed of in a normal regulated Ontario landfill site or recycled without any special type of treatment or disassembly.
- (j) The luminaire shall operate within specifications for an operating ambient temperature range of -40° C to + 40° C.



- (k) Luminaire shall meet ANSI C136.31 (current version) for 3.0 G vibration for use on normal streets, roadways and bridges.
- (l) The Vendor shall indicate the extent and nature of operational type testing for which the luminaire has been evaluated for the following:
  - (1) Ambient thermal cycling. (i.e. freeze — thaw)
  - (2) Ice formation and build-up.
- (m) Each luminaire shall be safety certified to CSA C22.2 No. 250.0-08 or have an equivalent listing from a recognized testing laboratory for the approved sale and use in Canada. Applicable labels shall be applied inside each unit.
- (n) Each luminaire shall have a label permanently fixed inside the unit that identifies the manufacturer's essential product information including date of manufacture, electrical schematic diagram, and operating specifications.

## ii. Photometric Performance

- (a) The luminaire LED light source shall emit white to cool white light with a nominal CCT in the range of  $4000^{\circ}\text{K} \pm 250^{\circ}\text{K}$ . Colour variation from the nominal luminaire rating over the operating life is to observe tolerance ranges consistent with ANSI standard C78.377-2008 "Specifications for the Chromaticity of Solid State Lighting".
- (b) The luminaire shall produce no lumen distribution above  $90^{\circ}$  vertical.
- (c) Colour Rendering Index (CRI) shall be  $\geq 65$ .
- (d) The luminaire shall be tested for photometric and electrical performance in accordance with the IESNA LM-79-08 "Approved Method for the Electrical and Photometric Measurements of Solid State Lighting Products". The test laboratory must hold National Voluntary Laboratory Accreditation Program (NVLAP) accreditation for the IES LM-79 test procedure. For more information, see [http://www1.eere.energy.gov/buildings/ssl/test\\_labs.html](http://www1.eere.energy.gov/buildings/ssl/test_labs.html).
- (e) A copy of the manufacturer's LM-79 photometric report shall be submitted for review.
- (f) The LED chip manufacturer shall have tested the lumen maintenance characteristics of the LED light source in accordance with the guidelines of IESNA LM-80-08 "Approved Method for Lumen Maintenance Testing of LED Light Sources". A copy of the manufacturer's LM - 80 reports shall be submitted for review.
- (g) The luminaire shall maintain a minimum of 85% of initial lumen output (L85) at 88,000 hours when operated within specified operating parameters at an ambient temperature of  $25^{\circ}\text{C}$ . The manufacturer shall indicate the actual lamp lumen depreciation (LLD) at 88,000 hours and at an ambient temperature of  $25^{\circ}\text{C}$  as calculated using procedures outlined in IES TM-21-11 (Projecting Long Term Lumen Maintenance of LED Light Sources). The manufacturer shall provide a total assembled luminaire system (LED package, housing, optical & electrical components) lumen depreciation curve for each separate wattage, drive current and distribution type proposed.

### **iii. Electrical**

- (a) The Luminaire shall contain a surge protection device (SPD) to protect all electrical and electronic components from harmful line transient voltage surges as a result of utility line switching, lightning strikes, or other electrical supply system disturbances. The SPD for luminaires to be wired at 120V shall meet a 10 kV/ 5 kA surge level and meet application and testing requirements per ANSI / IEEE C.62.41.2 for Category C operation and ANSI / IEEE C62.45. SPDs shall be designed to fail in the off position so as to help identify failed units and to continue to protect LED drivers and light engines from future power surges.
- (b) Utility supply wiring to the luminaire shall terminate in a barrier-type terminal block secured to the housing. The terminal block shall have wire grips suitable for No. 14 AWG to no. 6 AWG wire sizes. All internal wiring shall be copper, 600V rated and insulated to class N, 200°C.
- (c) The Luminaire shall be supplied with a photoelectric control receptacle which shall be a 7-prong twist-lock type conforming to ANSI standard C136.10 and capable of being adjustable directionally without tools.
- (d) The nominal operating voltage shall be 120 VAC +/- 10%, 60 Hz.
- (e) The LED driver shall be designed to operate maintenance-free for a minimum of 100,000 hours at 25° C ambient.
- (f) The LED driver shall have a power factor  $\geq 0.90$ .
- (g) The THD (current and voltage) induced into the AC supply line shall not exceed 10%.
- (h) Luminaire driver electrical/electronic component devices shall comply with Industry Canada ICES Interference Causing Equipment Standards for RF emissions.
- (i) Drivers with dimmable drive current ratings are required as a wireless monitoring/metering/dimming system is being used throughout the Town of Oakville.

### **iv. Quality Assurance**

- (a) Before bulk purchase, the Town of Oakville may request for inspection, one or more standard production-model luminaire samples identical (including LED package) to product proposed to be installed. Owner may request independent testing of sample luminaires to verify luminaire performance and compliance with the specifications.
- (b) After installation, the Town of Oakville may perform field measurements and/or send luminaires to an independent laboratory for testing to confirm photometric performance.

### **v. Packaging & Shipping**

- (a) The luminaire shall be shipped as a single self-contained unit in its own boxed container. The luminaire shall be fully assembled at the factory and

not require any on-site assembly. Each unit shall include installation and operating instructions.

**vi. Warranty**

- (a) The manufacturer shall warrant the full replacement of the luminaire due to any failure for a period of ten (10) years from date of delivery to the Town of Oakville stores.
- (b) In addition, the warranty shall provide for the repair or replacement of any electrical component due to manufacturing defect or failure of that component (including LED array and LED driver) for a period of 10 years from date of delivery. Alternatively, the manufacturer may opt to replace the entire luminaire at no cost to the Town of Oakville.

**V. Alternative Luminaires**

The town will consider having alternative cobra head style LED luminaires incorporated into its street lighting portfolio. Prior to evaluating alternative products the Town will require the following submittals for each luminaire type

- a. Product Cut-sheets
  - i. Shall indicate a complete and unique catalogue number for each product submitted.
  - ii. All components of catalogue numbers shall be identifiable as options and explained.
  - iii. Luminaire input current, LED drive current, and nominal Correlated Color Temperature (CCT) shall be clearly indicated.
  - iv. Shall include complete specifications for LED light source(s), including make/model number.
  - v. Shall include complete specifications for LED driver(s), including make/model number.
  - vi. Shall include documentation supporting claims of luminaire recyclability.
- b. Luminaire photometric report per IES LM-79 including:
  - i. The test laboratory must hold National Voluntary Laboratory Accreditation Program (NVLAP) accreditation for the IES LM-79 test procedure.
  - ii. Report number.
  - iii. Date.
  - iv. Complete luminaire catalogue number, consistent with submitted product cut-sheet.
  - v. Description of luminaire, LED light source, and LED driver(s).
  - vi. Photometry.
  - vii. Colorimetry.

- c. Computer-generated point-by-point photometric analysis of maintained light performance as per Table 3.
  - i. Calculations shall be for maintained values, i.e., Light Loss Factor (LLF)  $< 1.0$ , where  $LLF = LLD \times LDD$ 
    - Lamp Lumen Depreciation (LLD); determined by the process outlined in Design Criteria Section B.7.
    - Luminaire Dirt Depreciation (LDD) = 0.90, as per IES DG-4-03 for an enclosed and gasketed roadway luminaire installed in an environment with airborne particulate matter less than 150 microgram/m<sup>3</sup> and cleaned every five years.
  - ii. Calculation/measurement points shall be as per ANSI/IES RP-8-14 Figure A4.
- d. Documentation supporting claims of expected L85 useful life, as per ANSI/IES RP-8-14 Appendix A.
  - i. Provide IES LM-80 report from manufacturer of LED chip used in luminaire.
  - ii. Provide ISTMT report.
  - iii. Provide TM-21-11 computed charts illustrating interpolation between TMP curves from LM-80 data for lumen maintenance at TMP from ISTMT report.
    - TMP interpolation is only valid for the same drive current.
- e. Written manufacturers' product warranty per section D.2.b.vi. above.
- f. Safety certification and file number per the CEC. Recognized Testing Laboratories include: CSA (Canadian Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratory).

**Table 3: Lighting Performance Requirements for Typical Roadways**

**Note: See Appendix B for Standard Drawings**

| Typical Section # | Roadway Type | Pedestrian Conflict | Luminance cd/m <sup>2</sup> | Uniformity Avg/Min | Uniformity Max/Min | Veiling Luminance  | Sidewalk Illuminance (Lux) |
|-------------------|--------------|---------------------|-----------------------------|--------------------|--------------------|--------------------|----------------------------|
|                   |              |                     | (min)                       | (max)              | (max)              | $L_{Vmax}/L_{avg}$ |                            |
| 1                 | Local        | Low                 | 0.3                         | 6.0                | 10.0               | 0.4                | 3.0                        |
| 2                 | Local        | Medium              | 0.5                         | 6.0                | 10.0               | 0.4                | 5.0                        |
| 3                 | Collector    | Low                 | 0.4                         | 4.0                | 8.0                | 0.4                | 3.0                        |
| 4                 | Collector    | Medium              | 0.6                         | 3.5                | 6.0                | 0.4                | 5.0                        |
| 5                 | Collector    | Medium              | 0.6                         | 3.5                | 6.0                | 0.4                | 5.0                        |
| 6                 | Arterial     | Medium              | 0.9                         | 3.0                | 5.0                | 0.3                | 5.0                        |

g. Typical Sections for Design Verification

**Typical Section 1: Cobra Head Style** Dwg STD 7-22A Local Low: 2 Lane plus Parking.  
Sidewalk both sides. Maximum UPD; 0.18 W/m<sup>2</sup>.

Two sided, opposite 104 m spacing, 9.1 m MH, 2.4m Bracket Arm.

| Manufacturer<br>& Model | Total Unit<br>Input Watts | Sidewalk<br>Illuminance<br>Lux | Photometric Performance – Luminance |                           |                           |                               |
|-------------------------|---------------------------|--------------------------------|-------------------------------------|---------------------------|---------------------------|-------------------------------|
|                         |                           |                                | L Avg<br>cd/m <sup>2</sup>          | Uniformity<br>L avg/L min | Uniformity<br>L max/L min | Veiling<br>Luminance<br>Ratio |
|                         |                           |                                |                                     |                           |                           |                               |

**Typical Section 2: Cobra Head Style** – Dwg STD 7-22B Local Medium: 2 Lane plus Parking.  
Sidewalk both sides. Maximum UPD; 0.20 W/m<sup>2</sup>.

Two sided (Opposite), fixed 123 m spacing, 10.6 m MH, 2.4m Bracket arm.

| Manufacturer<br>& Model | Total Unit<br>Input Watts | Sidewalk<br>Illuminance<br>Lux | Photometric Performance – Luminance |                           |                           |                               |
|-------------------------|---------------------------|--------------------------------|-------------------------------------|---------------------------|---------------------------|-------------------------------|
|                         |                           |                                | L Avg<br>cd/m <sup>2</sup>          | Uniformity<br>L avg/L min | Uniformity<br>L max/L min | Veiling<br>Luminance<br>Ratio |
|                         |                           |                                |                                     |                           |                           |                               |

**Typical Section 3: Cobra Head Style** – Dwg STD 7-23 Collector Low: 2 Lane plus Parking.  
Sidewalk both sides. Maximum UPD; 0.17 W/m<sup>2</sup>.

Two sided (Staggered), 113 m spacing, 10.6 m MH, 2.4 m Bracket arm.

| Manufacturer<br>& Model | Total Unit<br>Input Watts | Sidewalk<br>Illuminance<br>Lux | Photometric Performance – Luminance |                           |                           |                               |
|-------------------------|---------------------------|--------------------------------|-------------------------------------|---------------------------|---------------------------|-------------------------------|
|                         |                           |                                | L Avg<br>cd/m <sup>2</sup>          | Uniformity<br>L avg/L min | Uniformity<br>L max/L min | Veiling<br>Luminance<br>Ratio |
|                         |                           |                                |                                     |                           |                           |                               |

**Typical Section 4: Cobra Head Style** – Dwg STD 7-24 Collector Medium: 2 Lane plus  
Parking both sides. Sidewalk both sides. Maximum UPD; 0.28 W/m<sup>2</sup>.

Two sided (Opposite), 109 m spacing, 10.6 m MH, 2.4 m Bracket arm.

| Manufacturer<br>& Model | Total Unit<br>Input Watts | Sidewalk<br>Illuminance<br>Lux | Photometric Performance – Luminance |                           |                           |                               |
|-------------------------|---------------------------|--------------------------------|-------------------------------------|---------------------------|---------------------------|-------------------------------|
|                         |                           |                                | L Avg<br>cd/m <sup>2</sup>          | Uniformity<br>L avg/L min | Uniformity<br>L max/L min | Veiling<br>Luminance<br>Ratio |
|                         |                           |                                |                                     |                           |                           |                               |

**Typical Section 5: Cobra Head Style – Dwg STD 7-25 Collector Medium: 4 Lane. Sidewalk both sides. Maximum UPD; 0.22 W/m<sup>2</sup>.**

Two sided (Staggered), 108 m spacing, 10.6 m MH, 2.4 m Bracket arm.

| Manufacturer & Model | Total Unit Input Watts | Sidewalk Illuminance Lux | Photometric Performance – Luminance |                        |                        |                         |
|----------------------|------------------------|--------------------------|-------------------------------------|------------------------|------------------------|-------------------------|
|                      |                        |                          | L Avg cd/m <sup>2</sup>             | Uniformity L avg/L min | Uniformity L max/L min | Veiling Luminance Ratio |
|                      |                        |                          |                                     |                        |                        |                         |

**Typical Section 6: Cobra Head Style – Dwg STD 7-26 Arterial Medium: 4 Lane. Bike Lane and Sidewalk both sides. Maximum UPD; 0.31 W/m<sup>2</sup>.**

Two sided (Staggered), 85 m spacing, 10.6 m MH, 2.4 m Bracket arm.

| Manufacturer & Model | Total Unit Input Watts | Sidewalk Illuminance Lux | Photometric Performance – Luminance |                        |                        |                         |
|----------------------|------------------------|--------------------------|-------------------------------------|------------------------|------------------------|-------------------------|
|                      |                        |                          | L Avg cd/m <sup>2</sup>             | Uniformity L avg/L min | Uniformity L max/L min | Veiling Luminance Ratio |
|                      |                        |                          |                                     |                        |                        |                         |

**Table 4: Summary of Performance**

| Typical Section # | Model # | Input Watts | Calculated LLD From TM-21 | Meets Photometric Performance Requirements Yes/No | Additional Comments |
|-------------------|---------|-------------|---------------------------|---------------------------------------------------|---------------------|
| 1                 |         |             |                           |                                                   |                     |
| 2                 |         |             |                           |                                                   |                     |
| 3                 |         |             |                           |                                                   |                     |
| 4                 |         |             |                           |                                                   |                     |
| 5                 |         |             |                           |                                                   |                     |
| 6                 |         |             |                           |                                                   |                     |

Date:

Vendor:

## I. Adaptive Control Technologies

The Town of Oakville has converted its outdoor lighting network to LED technology and installed a state of the art Outdoor Wireless Control System (OWCS). The OWCS produced by GE is a proprietary communication network formed by LightGrid Nodes installed on each street light which communicate wirelessly to the central management server via Gateways. It is the intent of the Town to continue to utilize the latest GE LightGrid technology for any new outdoor municipal street lights installed in the Town of Oakville as described below. The Design Engineer shall consult with the appropriate Town staff to confirm the equipment to be deployed for a specific geographical location.

### a. Gateways

- i. The existing GE Lighting's LightGrid OWCS 2.0 utilizes Gateways to connect the radio frequency (RF) mesh formed by the OWCS External Nodes installed on each street light. The nodes report the status of the lights and allow for remote control dimming and scheduling from the central management server. Gateways have been installed throughout the Town as part of the Town's 'Conversion of Outdoor Lighting Network to LED' project.
- ii. For new developments, the Developer shall install new Gateways at their own cost, if the Town deems it necessary to ensure adequate connectivity and response time. The Gateways shall be mounted on the roof or wall of a Town facility or on streetlight poles. The Town's Public Work Operations Division, in consultation with IT and Facility Design, Construction and Maintenance Divisions shall determine the appropriate location of any new Access Points.

### b. Smart Control Nodes

- i. All new municipal light fixtures installed shall be equipped with GE Lighting's LightGrid Nodes mounted on the fixture's 7-pin NEMA twist lock receptacle. The specific part numbers for the Nodes approved by the Town and corresponding luminaire type can be found in Table 5 below:

**Table 5: Approved Node Part Numbers**

| Manufacturer /Part Number | Part Description       | Luminaire Type                |
|---------------------------|------------------------|-------------------------------|
| ELWN0A5UG5                | 120-277 Volt Network A | LED Cobra Head and Coachlight |
| ELWN5A5UG5                | 480 Volt Network A     | LED Cobra Head and Coachlight |

## VI. Operational Practices

Town staff will review current street lighting practices and will update and enhance operational practices to include possible street lighting curfews, dimming, and maintenance requirements

### E. Light Shielding and Distribution

All street lighting shall have no light emitted above 90 degrees from nadir.

**Exception:** Decorative street lighting for specific districts or projects shall be permitted by special permit only, and shall meet the requirements of Table 6 below without the need for external field-added modifications.

**Table 6 - Uplight Control Requirements for Decorative Street Lights - by Special Permit Only**

| Lighting Zone* | Maximum Uplight Rating** |
|----------------|--------------------------|
| LZ-0           | U-0                      |
| LZ-1           | U-1                      |
| LZ-2           | U-2                      |
| LZ-3           | U-3                      |
| LZ-4           | U-4                      |

\*Lighting Zones are found in Oakville Municipal Outdoor Lighting Standard.

\*\* The Maximum Uplight Rating is derived from the BUG luminaire classification system.

### F. Definitions

| Table of Definitions   |                                                                                                                                                                                                                                                     |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Absolute Photometry    | Photometric measurements (usually of a solid-state luminaire) that directly measures the footprint of the luminaire. Reference Standard IES LM-7.                                                                                                   |
| Astronomic Time Switch | An automatic lighting control device that switches outdoor lighting relative to time of solar day with time of year correction.                                                                                                                     |
| Backlight              | For an exterior luminaire, lumens emitted in the quarter sphere below horizontal and in the opposite direction of the intended orientation of the luminaire. For luminaires with symmetric distribution, backlight will be the same as front light. |
| BUG                    | A luminaire classification system that classifies backlight (B), uplight (U) and glare (G). Reference Standard IES TM-15-07.                                                                                                                        |



|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Common Outdoor Areas       | One or more of the following: a parking lot; a parking structure; a common entrance or covered vehicular entrance, a common entrance or public space shared by all occupants of the domiciles.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Curfew                     | A time defined by the authority when outdoor lighting is reduced or extinguished.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Decorative Lighting        | Lighting that does not impact the function and safety of an area but is purely decorative, or used to illuminate architecture and/or landscaping, and installed for aesthetic effect.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Decorative Street Lighting | A luminaire intended for illuminating streets that serves a decorative function in addition to providing optics that effectively deliver street lighting. It has an historical period appearance or decorative appearance, and has the following design characteristics: <ul style="list-style-type: none"> <li>· designed to mount on a pole using an arm, pendant, or vertical tenon;</li> <li>· opaque or translucent top and/or sides;</li> <li>· an optical aperture that is either open or enclosed with a flat, sag or drop lens;</li> <li>· mounted in a fixed position; and</li> <li>· with its photometric output measured using Type C photometry per IESNA LM-75-01.</li> </ul> |
| Fully Shielded Luminaire   | A luminaire constructed and installed in such a manner that all light emitted by the luminaire, either directly from the lamp or a diffusing element, or indirectly by reflection or refraction from any part of the luminaire, is projected below the horizontal plane of the luminaire's lowest light-emitting part.                                                                                                                                                                                                                                                                                                                                                                      |
| Glare                      | Lighting entering the eye directly from luminaires or indirectly from reflective surfaces that causes visual discomfort or reduced visibility.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| IDA                        | International Dark-Sky Association                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| IESNA                      | Illuminating Engineering Society of North America                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Lamp                       | A generic term for a source of optical radiation (i.e. "light"), often called a "bulb" or "tube". Examples include incandescent, fluorescent, high-intensity discharge (HID) lamps, low pressure sodium (LPS) lamps, as well as light-emitting diode (LED) modules and arrays.                                                                                                                                                                                                                                                                                                                                                                                                              |
| LED                        | Light Emitting Diode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Light Pollution            | Any adverse effect of artificial light including, but not limited to, glare, light trespass, sky-glow, energy waster, compromised safety and security, and impacts on the nocturnal environment.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Light Trespass             | Light that falls beyond the property it is intended to illuminate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Lighting                   | "Electric" or "man-made" or "artificial" lighting. see "lighting equipment".                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Lumen                      | The unit of measure used to quantify the amount of light produced by a lamp or emitted from a luminaire (as distinct                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                | from “watt,” a measure of power consumption).                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Luminaire                      | The complete lighting unit (fixture), consisting of a lamp, or lamps and ballast(s) (when applicable), together with the parts designed to distribute the light (reflector, lens, diffuser), to position and protect the lamps, and to connect the lamps to the power supply.                                                                                                                                                                                                                                              |
| Lux                            | The SI (International System of Units) unit of illuminance. One lux is one lumen per square meter. 1 Lux is a unit of incident illuminance approximately equal to 1/10 footcandle                                                                                                                                                                                                                                                                                                                                          |
| New lighting                   | Lighting for areas not previously illuminated; newly installed lighting of any type except for replacement lighting or lighting repairs.                                                                                                                                                                                                                                                                                                                                                                                   |
| Object Height                  | The highest point of an entity, but shall not include antennas or similar structures.                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Outdoor Lighting               | Lighting equipment installed within the property line and outside the building envelopes, whether attached to poles, building structures, the earth, or any other location; and any associated lighting control equipment.                                                                                                                                                                                                                                                                                                 |
| Partly shielded Luminaire      | A luminaire with opaque top and translucent or perforated sides, designed to emit most light downward.                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Pedestrian Hardscape           | Stone, brick, concrete, asphalt or other similar finished surfaces intended primarily for walking, such as sidewalks and pathways.                                                                                                                                                                                                                                                                                                                                                                                         |
| Photoelectric Switch           | A control device employing a photocell or photodiode to detect daylight and automatically switch lights off when sufficient daylight is available.                                                                                                                                                                                                                                                                                                                                                                         |
| Property line                  | The edges of the legally-defined extent of privately owned property.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Repair(s)                      | The reconstruction or renewal of any part of an existing luminaire for the purpose of its ongoing operation, other than relamping or replacement of components including capacitor, ballast or photocell. Note that retrofitting a luminaire with new lamp and/or ballast technology is not considered a repair and for the purposes of this ordinance the luminaire shall be treated as if new. “Repair” does <b>not</b> include normal relamping or replacement of components including capacitor, ballast or photocell. |
| Shielded Directional Luminaire | A luminaire that includes an adjustable mounting device allowing aiming in any direction and contains a shield, louver, or baffle to reduce direct view of the lamp.                                                                                                                                                                                                                                                                                                                                                       |
| Sky Glow                       | The brightening of the nighttime sky that results from scattering and reflection of artificial light by moisture and dust particles in the atmosphere. Skyglow is caused by light directed or reflected upwards or sideways and reduces one's ability to view the night sky.                                                                                                                                                                                                                                               |
| Third Party                    | A party contracted to provide lighting, such as a utility company.                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

|                      |                                                                                              |
|----------------------|----------------------------------------------------------------------------------------------|
| Unshielded Luminaire | A luminaire capable of emitting light in any direction including downwards.                  |
| Uplight              | For an exterior luminaire, flux radiated in the hemisphere at or above the horizontal plane. |

## Appendix A

### List of Approved LED Traditional Coachlight and Cobra Head Style Luminaires

| Size (Watts) | Type | Manufacturer   | Part Number                                        | Total Input Power (Watts) | Street Class    |
|--------------|------|----------------|----------------------------------------------------|---------------------------|-----------------|
| 31           | II   | GE             | ERL1004A340AGRAYILR                                | 31                        | Local           |
| 47           | II   | GE             | ERL1006B340AGRAYILR                                | 47                        | Local/Collector |
| 98           | II   | GE             | ERLH011E340AGRAYILR                                | 98                        | Local/Collector |
| 120          | III  | GE             | ERL2016C340AGRAYILR                                | 120                       | Collector       |
| 140          | III  | GE             | ERL2018C340AGRAYILR                                | 140                       | Collector       |
| 251          | III  | GE             | ERL2028C340AGRAYILR                                | 251                       | Arterial        |
| 100          | III  | King Luminaire | K601D-S-P4NL-III-40(SSL)-7030-120-277-PR7-4K-6-HSS | 100                       | Local           |
| 100          | III  | King Luminaire | K601D-T-P4NL-III-40(SSL)-7030-120-277-PR7-4K-6-HSS | 100                       | Local           |

## Appendix B: ROW Drawings















