

**Appendix D –
Roadway Lighting Design Standard**



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Table of Contents

1.0	Region Directive	4
1.1	Definitions	4
1.2	Introduction and Objective	4
1.3	Standards	5
1.4	Codes and Regulation	5
1.5	Design Support Documents	6
1.6	Equipment	6
1.6.1	Luminaires	6
1.6.2	Poles	7
1.6.3	Power Supply	8
1.6.4	Junction Boxes	9
1.6.5	Ducts	9
1.6.6	Wiring	9
1.6.7	Fusing	10
1.6.8	Grounding	10
1.7	Intent to Light and Warrants	10
1.7.1	Street Lighting	11
1.7.2	Intersection Lighting	11
1.7.3	Walkway (Sidewalk), Bikeway, and Multi-use Path Lighting	11
1.8	Lighting Calculations	12
1.8.1	Calculation Software	12
1.8.2	Lighting Classifications	12
1.8.3	Light Loss Factor	13
1.8.4	Lighting Design Criteria	14
1.9	Design Planning and Methodology	14
1.9.1	Placement of Equipment	15
1.9.2	Utility Clearances	18
1.9.3	Light Trespass	19
1.9.4	Skyglow	19
1.9.5	Special Considerations	19
2.0	Consultants Work Plan	19
2.1	Lighting Design Startup	20
2.2	Lighting Classifications Proposal	20
2.3	Lighting Design Criteria Proposal	21

2.4	Site Investigation	21
2.5	Drawings Setup	21
2.6	Hydro Coordination for Lighting Use	21
2.7	Lighting Equipment Selection	22
2.8	Lighting Calculations.....	22
2.9	Hydro Coordination for Approvals.....	23
2.10	Approvals for Attachments to Hydro Poles.....	23
2.11	Approvals for Power Supply Connection Points.....	23
2.12	Removals Coordination	23
2.13	Detailed Design	24
2.14	Design Approval	25

1.0 Region Directive

1.1 Definitions

Consultant: The hired roadway lighting design Consultant, skilled specifically in roadway lighting design.

ESA: Electrical Safety Authority

FAWS: Field Adjustable Wattage Switch

LDC: Lighting Design Criteria

OESC: Ontario Electrical Safety Code

Owner: The Regional Municipality of Niagara

RFP: Request for Proposal

RFQ: Request for Quotation

Roadway Lighting Assembly: A complete assembly consisting of a pole, arm, and luminaire.

RP8: Recommended Practice for Design and Maintenance of Roadway and Parking Facility Lighting

Region: The Regional Municipality of Niagara's assigned Project Manager or designate.

1.2 Introduction and Objective

The Region is responsible for the design, installation and maintenance of all roadway lighting and associated facilities on roadways under the Region's jurisdiction. Roadway lightings facilities consist of, but are not limited to; street lighting, intersection lighting, midblock crosswalk lighting, roundabout lighting, sidewalk and pathway lighting, at-grade railway crossing lighting, etc.

The 'Niagara Region Roadway Lighting Design Standard' document has been created to assist the Region and their Consultants in defining the design requirements for roadway lighting systems.

The Region will engage qualified Consultants who are experienced in roadway lighting design. It is imperative that the individuals involved with the design of roadway lighting systems have prior education, knowledge, and experience in this field. The design Consultant must have staff actively engaged in each project with a minimum of 10 years of roadway lighting design experience.

The following shall be considered the objectives of a roadway lighting system design:

- Lighting levels in accordance with the latest RP-8 recommendations are to be achieved for all roadway lighting facilities (street, intersections, path/bikeways, etc.) on regional roads.
- Where it is not economically possible to achieve lighting in accordance with RP-8 recommendations for a roadway lighting facility being designed, engineering judgement shall be applied to best suit the given conditions.
- All roadway lighting systems shall be designed to be energy and cost efficient with respect to initial installation and life-time maintenance.

This standard has been prepared to provide roadway lighting design Consultants with the fundamental baseline information to design roadway lighting systems in accordance with the Region's intended expectation. As this standard does not cover every situation that may be encountered, it is the responsibility of the Consultant to exercise professional engineering judgment during every stage of the design process.

1.3 Standards

The Region endorses and recognizes the following document(s) as their roadway lighting design standard:

- ANSI/IES RP-8 RECOMMENDED PRACTICE FOR DESIGN AND MAINTENANCE OF ROADWAY AND PARKING FACILITY LIGHTING

This document is to be utilized and applied for all roadway lighting design projects within the Region's right of way. The Region requires the latest version of the listed and supporting documents be utilized when designing roadway lighting systems within the Region.

The recommendations of the RP-8 shall be used, along with engineering judgement, to set the performance and installation criteria for the lighting systems.

During the design process, the Consultant shall identify specific instances where the recommendations of the RP-8 cannot be met. The Consultant shall contact the Region's Project Manager in writing and identify the specifics in which the standard cannot be met. The Consultant shall provide recommendations on how to proceed to address the nonconformance. The Region will then review the recommendation and provide direction to the Consultant on how to proceed.

1.4 Codes and Regulation

The Region recognizes and the following codes and regulations for roadway lighting design:

- C22.1 ON-18: ONTARIO ELECTRICAL SAFETY CODE

- O.REG. 22/04: ELECTRICAL DISTRIBUTION SAFETY

The above listed codes and regulations must be fully adhered to for all roadway lighting designs and installations.

1.5 Design Support Documents

The following listed documents are to be used by the Consultant as required to complete the lighting design and can be found on the following web page:

[Traffic Signal and Illumination Standards - Niagara Region, Ontario](#)

- Appendix B –Niagara Region Standard Detailed Drawings
- Appendix C - Niagara Region – Transportation - Approved Product and Equipment List (APEL)
- Appendix I – Lighting Warrants

[How We Go - Niagara Region, Ontario](#)

- Niagara Region Complete Streets Design Guidelines

1.6 Equipment

The Region has compiled and endorses the use of the products and equipment listed in the ‘Niagara Region – Transportation - Approved Product and Equipment List (APEL)’ for use on all roadway lighting projects. See Section 1.5 for a link to the current version located on the Region’s website.

The Region may supply certain roadway lighting equipment and appurtenance items for installation on projects. The Consultant shall obtain a list of the items the Region intends to supply on for each project. These items are to be included in the contract design documents for installation only.

1.6.1 Luminaires

The Consultant shall utilize the ‘APEL’ to select luminaires for use on all roadway lighting projects. The Consultant shall contact the luminaire representative to obtain the current photometric file (.IES) for the selected luminaire to be used for the lighting calculations.

The Consultant shall verify with the Region if decorative luminaires are to be used and if so, what Correlated Colour Temperature (CCT) should be used. Typically, “warmer” CCT’s (IE. 2700-3000) are preferred when utilizing heritage style luminaires.

The Consultant shall obtain the current luminaire data required to calculate the FAWS output. As the luminaire output data changes with each new version of the luminaire, this new data shall be obtained with each new luminaire .IES file acquired.

The Region typically utilizes a centrally controlled lighting system with a single photocell located on the power supply pole. On installations utilizing hydro poles with luminaires feed from hydro's secondary bus, the luminaires shall be individually photo controlled.

1.6.2 Poles

Pole Type (Decorative/Conventional)

Projects in which lighting equipment is not being installed on hydro poles, sectional steel poles with concrete footings shall be used. Direct buried sectional steel poles may be used when placed in soft surfaces, such as sod and gravel. The Consultant shall obtain the Region's approval to utilize direct buried sectional steel poles prior to the commencement of a design.

Aerial cables shall not be attached to any direct buried poles other than power supply poles.

The 12 local municipalities within the Region have the option to request that decorative (steel or concrete) poles be used for roadway lighting on any given project. The Region's Project Manager will contact the local municipality during the design phase of a project to determine if the municipality requests the use of decorative poles.

The local municipality will be required to fund the additional costs involved with the use of decorative poles. If a request is made for decorative poles, Region staff will internally consult and determine if decorative poles will be used on the project. The Region's project manager will provide direction to the Consultant if decorative poles are to be used on a project.

When decorative poles are used for roadway lighting, the option is available for a local municipality to request that the Region provide 120 volt receptacles for external pole features such as seasonal lighting. The Region's Project Manager will consult with the local municipality to determine if the receptacles are required.

The maximum allowable load per pole for a seasonal feature is 150 watts. Separate circuits and wiring including fusing at each pole shall be provided for the seasonal feature receptacles.

Niagara Region Standard Drawing NRS 2522 details dimensions for decorative appurtenances on lighting poles. (Appendix B - Niagara Region Standard Detailed Drawings)

Setback and Placement

If concrete poles are selected for use on a project, the poles shall be direct buried and placed to meet clear zones as described in the Transportation Association of Canada (TAC) – Geometric Design Guide for Canadian Roads (current version). The Consultant shall confirm the projects clear zones with the road design Consultant or the Region.

Concrete poles or other non-frangible type poles are not permitted to be installed within the clear zone. If it is determined that the clear zone cannot be met within a project limit, in part or in whole, the project is to be designed with one type of pole that suits the clear zone requirements. Alternating pole types and setbacks are not acceptable. However, if a project clear zone permits the transition from one pole type to another this transition shall be reviewed and confirmed with the Region before implemented into the roadway lighting design.

1.6.3 Power Supply

The roadway lighting electrical power requirements are dependent on whether the roadway lighting is installed on utility poles or are freestanding Region owned pole assemblies.

Roadway Lighting on Systems Hydro Poles

When the roadway lighting arms and luminaires are installed on hydro poles, the hydro supplied secondary bus shall be used for the luminaire power feed. Each luminaire is to be connected to the secondary bus using the approved fuse assembly. All wiring from the fuse assembly to the luminaire shall be installed in the elliptical aluminum roadway lighting arm.

The Consultant shall coordinate each connection to the hydro's secondary bus and obtain acceptance to connect.

The Consultant shall coordinate all lighting attachments with the hydro authority that owns the hydro pole the equipment is being installed on. The consultant shall review and confirm the approval process and requirements to obtain approvals to install lighting on hydro poles from the hydro authority the equipment is intended to be installed on.

Standalone Region Owned Roadway Lighting Systems

When roadway lighting is installed on Region owned poles, the power supply assembly shall be installed in locations determined by the Consultant. A power supply assembly shall consist of a direct buried sectional steel pole with an overhead or underground power connection to the hydro utility. The Region's current process includes for the install of the poles and riser ducts to be installed by the electrical Contractor. The Region will then complete the power supply assembly installation including the supply and installation

of the power supply, meter base and associated appurtenances. Installation shall be in accordance with NRS 2130.

On lighting projects where there is a nearby traffic signal installation that the Region will be supplying and installing a power supply assembly for power to feed the traffic signals and intersection lighting, the Consultant shall coordinate adjacent roadway lighting designs with intent to utilize this power supply whenever possible to minimize the number of power supply assemblies. The Consultant shall add additional power supply assemblies as required for the roadway lighting system being designed outwards from the intersections. Voltage drop calculations required to determine the limitations of the power supply assemblies feeder outreach capabilities, shall be completed in accordance with the OESC requirements. Power supply assembly locations shall be reviewed and confirmed with the Region. On projects where a nearby existing traffic signal power supplies exists, the Consultant shall consider as an option for power supply to new roadway lighting system. The Consultant shall contact the Region to confirm if the existing power supply has sufficient space available within the panel for the new proposed loads.

The Consultant shall coordinate each connection to the hydro's secondary bus and obtain acceptance to connect.

1.6.4 Junction Boxes

Junction boxes shall be provided at the base of each Region owned street lighting pole. Junction boxes shall be located in accordance with NRS 2020.

1.6.5 Ducts

For freestanding Region owned lighting pole assembly systems, all roadway lighting pole assemblies shall be connected by an underground duct system. Ducts shall be installed in accordance with NRS 2020 (Appendix B - Niagara Region Standard Detailed Drawings).

Underground duct(s) entering concrete or steel direct bury poles shall be installed in accordance with Niagara Region Standard NRS 2820.

Surface mounted conduit on concrete or wooden poles shall be installed as per Niagara Region Standard drawings NRS 2800 and NRS 2810 respectively.

1.6.6 Wiring

The Consultant shall design the lighting distribution system in accordance with the Electrical Safety Authority (ESA) and the Ontario Electrical Safety Code (OESC) requirements. All wiring to the roadway lighting poles shall be installed within the duct systems.

Power Supply Feeder Cables

Power supply feeder cables are the cables extending from the connection point at the hydro authority's power source to the roadway lighting power supply assembly (distribution panel). These cables shall be #2 AWG RWU90 XLPE type cables. Hot cables shall be black, and the neutral cables shall be white.

Lighting Load Cables

Lighting load cable runs (between poles) shall be copper (#6 AWG minimum to #2 AWG maximum) RWU90 insulation. All conductors shall be colour coded (red, black, and white). Wiring Details included in Appendix B - Niagara Region Standard Detailed Drawings. The Consultant shall select the cable size based on the voltage drop calculations in accordance with ESA and OESC requirements. Lighting shall be fed with alternating circuits by using two runs with separate neutrals (IE. Red/White and Black/White) for each direction.

1.6.7 Fusing

The Consultant shall include all necessary fusing of lighting equipment in accordance with the OESC and ESA regulation and requirements.

1.6.8 Grounding

The Consultant shall design the grounding system in accordance with the ESA and the OESC. All wiring to the roadway lighting poles shall be installed within the duct systems.

Ground rods used shall be copper clad 3mx19mm DIA. as listed within the 'APEL' ([see section 1.5](#))

Concrete Lighting Poles

Ground rods shall be placed starting at the third pole outward from the power supply assembly and then every third pole thereafter. The last pole in each the distribution shall also receive a ground rod. If ground plates are found to be an appropriate choice for installation, the use of ground plates shall be approved by the Region for the specific installation.

Sectional Steel Lighting Poles

A ground rod shall be located at all sectional steel poles. The ground rod shall be connected to the ground lug on the pole using #6 AWG RWU90 XLPE Insulated (green) copper wire and mechanical connectors.

1.7 Intent to Light and Warrants

The Region has different types of roads and associated public access facilities within its jurisdiction. It is not the Region's objective or intent to provide roadway lighting on all roadway facilities. The consultant shall complete a warrant analysis to determine the roadway lighting requirements.

1.7.1 Street Lighting

The Region has prepared warranting tools (Appendix I – Lighting Warrants) to determine if lighting is warranted for midblock and intersection roadways. The warranting tool shall be utilized on all roadway projects. The Consultant shall obtain the current version of the lighting warranting tool from the Region for each project.

1.7.2 Intersection Lighting

It is the Region's intent that all new and existing intersections (signalized or unsignalized) within the Region's jurisdiction be illuminated in accordance with RP-8 recommendations. Existing intersections will be reviewed and prioritized as funding becomes available as well as when road upgrade and reconstruction projects envelop currently unlit intersections. Delineation (Beacon) lighting is the minimum requirement for all unsignalized intersections within the Region's jurisdiction. Delineation, partial or full intersection lighting shall be implemented at intersections in accordance with RP-8 recommendations. Furthermore, all signalized intersections will either be partially or fully lit, depending on where they are situated within existing lit or unlit roads.

1.7.3 Walkway (Sidewalk), Bikeway, and Multi-use Path Lighting

It is not the Region's intent to light all sidewalks on new or reconstructed roadways. Pedestrian lighting, whether part of the Roadway lighting system, or independent supplementary sidewalk lighting systems, shall be installed at the budgetary discretion of the Local Area Municipality and will adhere to RP-8 guidelines. During the RFP/RFQ stage, the Consultant shall confirm with the LAM if the sidewalks are to be lit and if a supplemental lighting system is to be designed. The Consultant must provide cycle by cycle lighting calculations on all sidewalks for all luminaire cycles within the project limits.

If it is determined that sidewalk lighting is not required as part of the new or reconstructed roadway, the Consultant should proceed with a design that provides lighting optimal for the roadway with reasonable consideration given for the sidewalks within the project. The Consultant shall provide continuous block by block lighting calculations on all sidewalks within the project limits.

The Consultant shall use engineering judgement when designing lighting for bike lanes of on road and off-road facilities. General guidance should be obtained from OTM Book 18, TAC and RP-8 although guidance from these documents is partial at best. It is recommended that designers shall review the forthcoming 2022 FHWA Lighting Handbook once released for further information on lighting bike facilities.

The Consultant shall use engineering judgement when designing lighting for multi-use paths. General guidance should be obtained from TAC and RP-8.

1.8 Lighting Calculations

The Region requires lighting calculations be performed for all roadway lighting facilities being designed. The lighting calculations must be completed by the lighting design Consultants. The Region will not accept lighting calculations that have been completed by a third party or lighting manufacturer.

The Consultant shall prepare the lighting calculation for all roadway facilities (Street, Intersection, Sidewalks, Walkway, At-grade crossings, mid-block crossing, etc.) within the project limits that are intended to be lit. On projects in which homogenous road and lighting geometrics exist, lighting calculations are only required for one representative cycle. Where non-homogenous road and lighting geometrics exist, the Consultant shall calculate each cycle in accordance with RP-8.

Projects that fall within the MTO's jurisdiction for review may require additional lighting calculations and coordination requirements. The consultant shall determine if the project is within the MTO's jurisdiction and, where required, contact them to obtain an understanding on the lighting requirements specific to the project.

1.8.1 Calculation Software

The Consultant shall use a lighting calculation software program such as AGi32 or AutoLUX. If an alternate software program is desired, the Consultant shall submit a formal request to the Region for consideration.

1.8.2 Lighting Classifications

The Region endorses various classifications within the RP-8 recommendation. These classifications are required to be defined for each project to carry out the roadway lighting calculations. The selection of these classifications is determined from the data obtain from the Region and relies heavily on engineering judgment and must be set in consultation with the Region prior to commencement of the design.

Street Classification (SC)

To set the lighting design criteria for a project, all the streets within a project's limits, shall be classified in accordance with the definitions as outlined within the RP-8 under the Street Classifications section.

If the Street Classification as defined within the RP-8 is not clear due to uncertainty of real-life application, the Consultant shall obtain the latest AADT (Annual Average Daily Traffic) counts from the Region to assist in selecting the classification. The Region

considers a 'Major' Street Classification if the traffic counts are more than 5000 vehicles per day, and a 'Collector' street classification if less than 5000 vehicles per day.

The Consultant shall include the Street Classifications identifying each Street Classification within the project limits, including tie-in streets, within the 'Lighting Classifications Proposal' and submit to the Region for acceptance prior to proceeding with a design.

Pedestrian Activity Classification (PAC)

To set the lighting design criteria for a project, all the streets within a project's limits, shall be classified in accordance with the definitions as outlined within the RP-8 under the 'Pedestrian Activity Classifications' section.

The Consultant shall include the Pedestrian Activity Classifications identifying each Pedestrian Activity Classification within the project limits, including tie-in streets, within the 'Lighting Classifications Proposal' and submit to the Region for acceptance prior to proceeding with a design.

Road Surface Classifications/Pavement Classification (PC)

To set the lighting design criteria for a project, all the pavements/surfaces being calculated utilizing the 'luminance' lighting calculation method, shall be classified in accordance with the definitions as outlined within the RP-8 under the Road Surface Classification section. The Region typically uses a Road Surface Classification R3 for their typical black asphalt road surfaces.

The Consultant shall include the 'Road Surface Classifications' identifying each Road Surface Classification within the project limits, including tie-in streets, within the 'Lighting Classifications Proposal' and submit to the Region for acceptance prior to proceeding with a design.

1.8.3 Light Loss Factor

The lighting calculations shall be completed utilizing a calculated light loss factor (LLF) for each selected luminaire within a project.

The calculated Light Loss Factor (LLF) for each LED roadway lighting fixture shall be the result of the Lamp Lumen Depreciation (LLD) multiplied by the Luminaire Dirt Depreciation (LDD).

$$\text{LLD} \times \text{LDD} = \text{LLF}$$

The LLD factor shall be based on the light output of the luminaire at 60,000 hours (13.5 years of use) at an average nighttime temperature of 10° C. The Consultant shall obtain

the current TM-21 and LM-80 reports from the luminaire manufacturer for each luminaire used.

The LDD factor can vary for different local environmental situations depending on the location of the roadway. The Consultant can typically use an LDD value of 0.85 for most projects which considers a relaxed maintenance program for the cleaning of luminaires as well as a clean environment. If the environmental surroundings on a project are in question, the Consultant shall coordinate with the Region to select an appropriate LDD value.

When utilizing the luminaires with the FAWS feature, the Consultant shall further adjust the LLF in order to evaluate the effects of the various FAWS settings within the lighting calculation. The Consultant shall obtain the current FAWS data to determine the multiplication factor relative to the output settings selected. The FAWS data is updated and revised with each luminaire update and release.

The LLF shall be clearly identified on all lighting calculation submission to the Region.

1.8.4 Lighting Design Criteria

The lighting design criteria shall be selected for all areas to be lit within the project limits. The Consultant shall select the lighting design criteria in accordance with the latest RP-8 recommended practices.

The Consultant shall strive to meet the set lighting design criteria for each project. It is understood that certain site constraints will not permit all roadway facilities to be lit in full compliance with the lighting design criteria. In the event the lighting criteria cannot be met, the Consultant shall reasonably exhaust various options and configurations in attempt to meet the lighting design criteria for the given scenarios. The Region may request lighting trial summaries be provided for various options tried as verification of the Consultants attempt to meet the lighting design criteria.

Over Lighting

The Region does not intend to over light any roadway facility. The Consultant shall ensure lighting designs are as close as possible to the set lighting design criteria values. Lighting designs that exceed the average values by more than one whole value may be required to revisit their calculations to ensure the lighting design criteria cannot be met (IE. Calculation result is 5 lx when LDC is 4 lx means your result is 25% above design criteria).

1.9 Design Planning and Methodology

The Region requires all roadway lighting facility designs to be well thought out, considering current recognized design standards and practices, past project experiences (lessons learned) as well as engineering judgment. Specific items for implementation and consideration while design lighting systems on regional roads are outlined in this section.

1.9.1 Placement of Equipment

The Consultant shall place roadway lighting equipment with the following items considered.

Luminaires on Hydro Poles

One of the Region's desired objectives for a roadway lighting design is to provide adequate roadway lighting in the most economical manner. The Region has determined that mounting luminaires on hydro poles and utilizing the hydro's secondary power bus is the most economical method of installation.

In the predesign phase of a project, the Consultant shall examine the feasibility of mounting roadway luminaires on an existing hydro pole line that is adjacent to the roadway and utilizing the hydro secondary bus for luminaire power supply.

In some roadway designs it may be necessary to install roadway lighting on both sides of the roadway. In these situations, it may be necessary to utilize a combination of luminaires mounted hydro poles and Region owned poles.

Lighting Pole Assembly Arrangement

The Region's preferred roadway lighting pole assembly arrangements are as follows:

- Single side - Boulevard, lighting pole assemblies located on one side of a roadway with one or two lanes (See Figure 1);
- Double side staggered - Boulevard, lighting pole assemblies located on both sides of a roadway with 3 or more lanes (See Figure 2);
- Single side - Median, lighting pole assemblies located within the median of a roadway with 4 or more lanes (See Figure 3);
- Double side staggered - Median and Boulevard, lighting pole assemblies located within the median and in the boulevard of a roadway with 4 or more lanes (See Figure 4).

The Consultants design shall utilize the Region's preferred lighting pole assembly arrangements. If a more suitable alternative arrangement is required, depending on the specifics of a certain project, the Consultant shall discuss with the Region to confirm the direction to proceed.

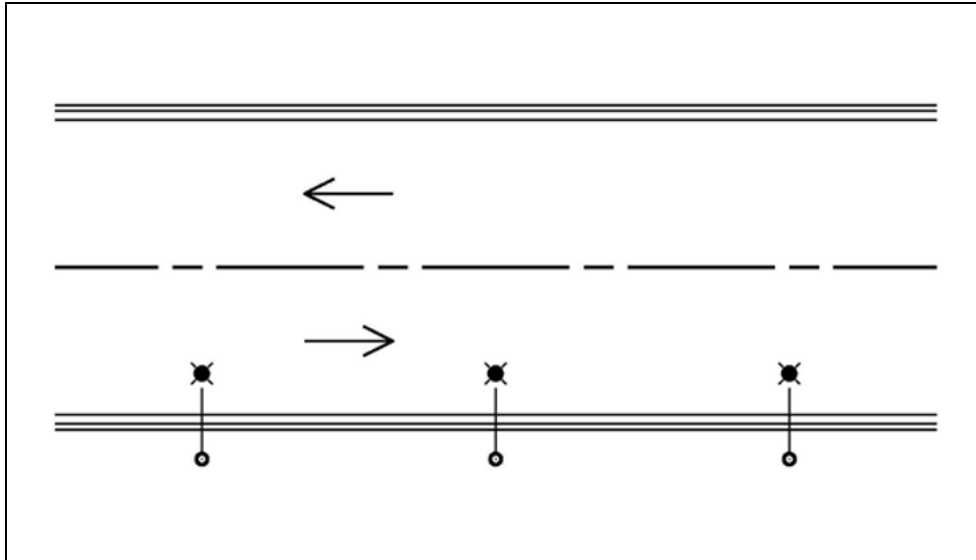


Figure 1 - Single side - Boulevard

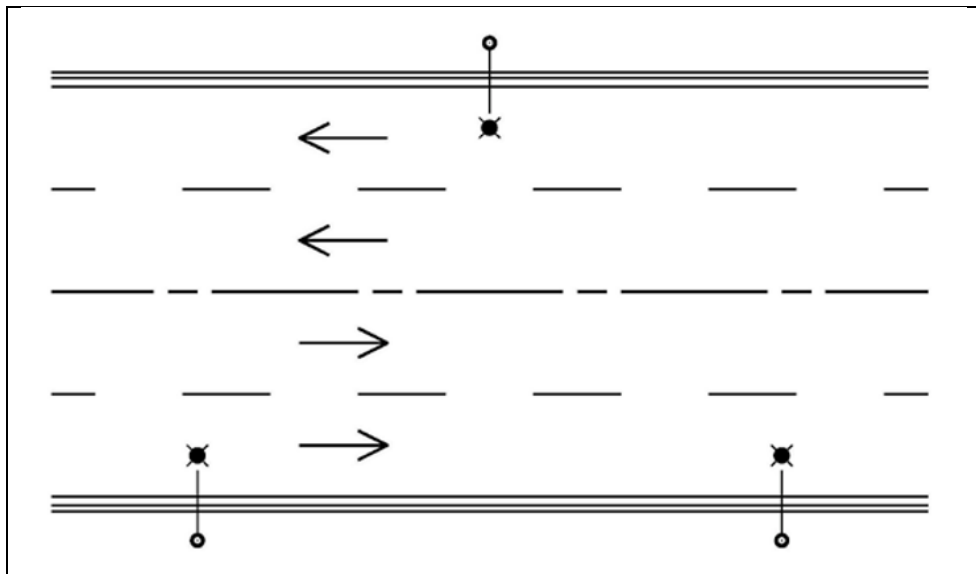


Figure 2 - Double side staggered - Boulevard

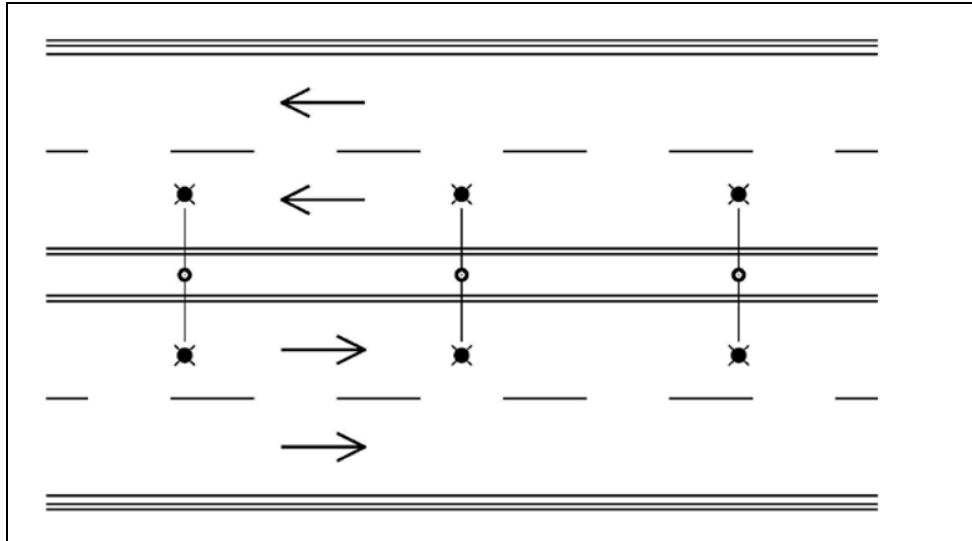


Figure 3 – Single side - Median

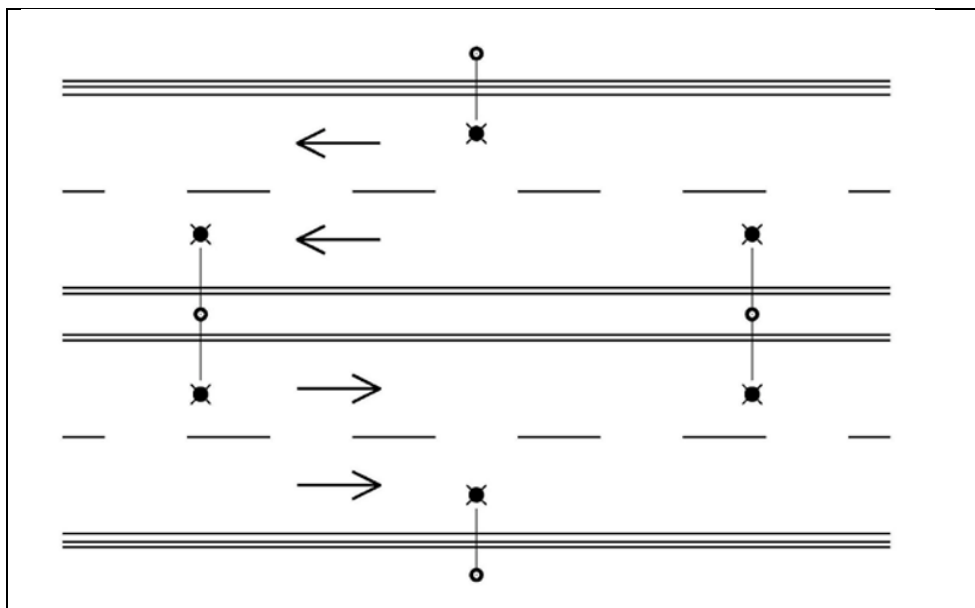


Figure 4 – Double side staggered - Median and Boulevard

Lighting Pole Assembly Setback

The Consultant shall obtain the required clear zone from the road design Consultant or Region for all projects. The Consultant shall confirm with the Region if the clear zone shall define the poles setbacks or if the Region has an alternate setback direction given the project specifics.

Concrete Poles

Typically, Region owned concrete freestanding lighting pole assemblies shall be setback in accordance with the TAC recommendations.

Sectional Steel

Typically, Region owned freestanding sectional steel lighting pole assemblies can be placed within the clear zone as the poles are considered collapsible. However, the designer shall consider placement of poles to meet the clear zone, or as close to, whenever possible. Poles placed in the clear zone shall have a minimum clearance of 0.5m from back of curb.

1.9.2 Utility Clearances

Existing Utilities to Remain

The Consultant shall ensure that all proposed new lighting equipment shall meet the required clearances to existing utilities as set out by the various utilities encountered within a project. The Consultant is required to coordinate with each utility to confirm and obtain current clearance requirements.

New Utilities to be Constructed

The Consultant shall coordinate with all utilities designing new infrastructure on projects to ensure that the proposed new roadway lighting equipment be installed in intended locations for optimal performance of the lighting. As lighting poles are above grade and shifts in pole lines (single or multiple) can impact the lighting performance of the lighting and are unsightly, every effort should be made for conflicting proposed new underground utilities be adjusted to avoid this conflict.

Trees

The lighting designer shall take note of existing and proposed trees within the project. If there are existing trees, the designer shall consider their location and impact on the lighting when locating lighting pole assemblies. If locating lighting pole assemblies near trees is unavoidable, the design shall include for tree trimming to be included at the time of the installation. The designer shall also coordinate with the Region for including the problematic areas within their current tree trimming program that will maintain the integrity of the lighting system. Additionally, when placing poles and ducts systems near mature trees, the design shall include for subsurface installation of ducts or hand digging around tree roots in order to mitigate damage to the roots.

1.9.3 Light Trespass

The Region intends for lighting systems to be designed such that the light trespass onto adjacent properties, structures or roadways shall be kept to a minimum, if not completely avoided. The Consultant shall prepare lighting designs in accordance with the recommendations on light trespass within the RP-8.

Where a design cannot avoid substantial light trespass on certain adjacent facilities, the Consultant shall discuss mitigative measures with the Region for the specific scenario.

1.9.4 Skyglow

The Region intends for lighting systems to be designed to mitigate skyglow. The Consultant shall prepare the lighting designs in accordance with the recommendations on skyglow within the RP-8.

The Consultant shall take additional measures to limit skyglow such as avoiding tilting luminaires within a design, as well as avoiding over lighting which results in light reflecting off the roads surface and contributing to skyglow.

1.9.5 Special Considerations

Gaps between Continuous Lighting Systems

Sections of unlit roads with distances of 500m or less between two continuous lighting systems should be lit.

Geometric Areas of Change

Sections of roads that have unanticipated geometric changes (IE. Sharp curves, reverse curves, and vertical or horizontal alignment changes) which can be challenging and limit the driver's ability to navigate safely through the section of road shall be considered for lighting. Engineering judgment shall be exercised when determining if lighting should be implemented. These types of areas should be identified during the proposal stage of a project and presented to the Region as a question for the Region to advise on how they want to address it. Should these conditions come up during the design stage, the lighting designer shall communicate with the Region on how the Region wants to address the specific condition(s). The consultant shall identify such unique geometrics and provide lighting recommendations to the Region.

2.0 Consultants Work Plan

This section details the tasks required to be completed by the Consultant. All design items being carried out by the Consultant throughout the design process shall be in accordance the Region's design directive as outlined within this document.

2.1 Lighting Design Startup

Before the lighting design commences, the Consultant shall confirm with the Region's Project Manager the communication protocol. The appointed Region contact will be the person the Consultant will direct all roadway lighting design questions to.

The Consultant shall confirm that following items with the Road Design Consultant:

- Obtain the clear zone(s) within the project limits.

The Consultant shall confirm with the Region all the listed pre-design startup questions:

- Is the APEL posted on the Region's website is the most current and no additional newly approved equipment is to be considered for the project?
- Is decorative lighting required?
 - If so, are seasonal receptacles required?
 - If so, what correlated colour temperature (CCT) is to be used?
- Are there budgetary constraints that restrict the lighting design?
 - Sectional steel poles with footing vs direct buried sectional steel poles
- What is the Region's direction in regards to the pole setbacks given the clear zone(s) provided by the road design Consultant?
- Obtain confirmation with the LAM if sidewalks are to be lit and if so, is the LAM interested in supplementary lighting system to light the sidewalk if required?
- Obtain confirmation from the Region if the lighting design is to utilize the hydro poles, or a freestanding Region owned lighting system.

The Consultant shall obtain all required listed information and design direction:

- Obtain list of equipment the Region intends to supply
- Obtain direction on what the Region wants to do with any equipment to be removed
- Obtain confirmation from the Region is there are nearby existing power supplies that can be utilized for the new roadway lighting system being designed. If so, how many circuits are available for new lighting loads.

2.2 Lighting Classifications Proposal

The Consultant shall prepare a lighting classification proposal that includes the Road Classifications, Pedestrian Activity Classifications and Road Surface Classifications on a key map and provide to the Region's Project Manager for the Region's approval. The lighting classifications proposals shall also include road names (every road that is within the project limits), project limits and north arrow.

2.3 Lighting Design Criteria Proposal

Once the lighting classification plan is complete and accepted by the Region, the Consultant shall prepare the lighting design criteria proposal for all roadway facilities to be lit in accordance with RP-8 recommendations.

2.4 Site Investigation

The Consultant must visit the site to complete a visual inspection of the areas to be lit and tie-ins to existing lighting or unlit sections or roads for consideration within the design. The Consultant shall take note of the following items to incorporate into the design:

- All existing equipment that is to be removed as well as a complete photo log for use during the lighting design.
- Adjacent properties for consideration of light trespass onto and from the properties
- Conflicts with other utilities (both below and above ground) and objects in the field (I.E. trees, aerial hydro cables, etc.)

2.5 Drawings Setup

The Consultant shall utilize the detailed design drawings and current existing topographical survey data provided as well as other supporting drawings as provided by the roadway design Consultant. It is advised that the roadway lighting detailed design does not commence until the road geometrics and pavement markings are confirmed to be static. If the lighting design project does not consist of a lighting design component, the Consultant is to coordinate with the Region for the most appropriate way to develop the layout for the design purposes.

Drawings shall be setup utilizing a minimum printed drawing scale of 1:500. Large scales (I.E. 1:200) are preferred and sometimes even required to show specific details for proper layout of equipment.

All drawings are to be prepared in meters (m) for layouts and meters (m) or millimeters (mm) for details.

All drawings shall be setup utilizing the current Niagara Peninsula CAD Standards.

2.6 Hydro Coordination for Lighting Use

The Consultant shall determine what the hydro authorities' plans are for existing or new hydro poles within the project limits.

Hydro Poles Existing

If hydro poles currently exist and there are no plans for hydro to upgrade or modify the existing hydro poles and plant, the Consultant shall confirm with hydro if the existing hydro poles within the project limits are suitable for installation of lighting equipment.

The Consultant shall coordinate and confirm the hydro authorities' limitations and requirements for mounting lighting equipment on existing hydro poles.

The Consultant shall confirm with the hydro authority what the requirements are to obtain approvals for all attachments to the existing hydro poles.

The Consultant shall then prepare their lighting design incorporating the limitations and requirements for installing new lighting equipment on existing hydro poles and submit their design and documentation required and obtain hydro's approval to mount on the hydro poles.

New Hydro Poles

When new hydro poles are being designed and constructed within a project's limits, the Consultant shall coordinate with hydro for the new hydro design to accommodate the requirements of the lighting.

The Consultant shall coordinate and confirm the hydro authorities' limitations and requirements for mounting lighting equipment on new hydro poles.

The Consultant shall confirm with the hydro authority what the requirements are to obtain approvals for all attachments to the new hydro poles.

The Consultant shall then prepare their lighting design incorporating the limitations and requirements for installing new lighting equipment on new hydro poles and submit their design and documentation required and obtain hydro's approval to mount on the hydro poles.

2.7 Lighting Equipment Selection

The Consultant shall select the lighting equipment necessary for preparation of the lighting calculation (poles, arms, luminaires) and prepare a Lighting Equipment Selection Summary with their intended use within the project using the products listed within the APEL. The Lighting Equipment Selection shall be forwarded to the Region for acceptance to proceed with the design. The lighting equipment selection summary can be prepared in an email to the Region.

2.8 Lighting Calculations

The Consultant shall prepare lighting calculations in accordance with the Region's directive within this document as well as RP-8 recommendations.

When preliminary lighting calculations have commenced and if alternative lighting design approaches are presented due to the preliminary lighting calculation results, the Consultant is to discuss alternatives with the Region to resolve a path forward to complete the lighting calculations and design.

The Consultant shall submit the lighting calculation along with the accepted lighting design criteria proposal for the Region's review. At that time, the Region will review and provide inquiries regarding the specifics of the lighting calculation, comments for items to be addressed or acceptance to proceed with the detailed design.

2.9 Hydro Coordination for Approvals

The Consultant shall contact the appropriate hydro authority and confirm the requirements for all approvals necessary for the installation of lighting equipment on hydro poles as well as power feed to the lighting systems.

2.10 Approvals for Attachments to Hydro Poles

The Consultant shall coordinate and obtain the approval(s) for all planned attachments to existing or new hydro poles from the local hydro authority. A copy of the approval(s) must be provided to the Region for their records.

2.11 Approvals for Power Supply Connection Points

The Consultant shall coordinate and obtain the approval(s) for all planned power supply feeder points at existing or new hydro poles or transformers from the local hydro authority. A copy of the approval(s) must be provided to the Region for their records.

2.12 Removals Coordination

The Consultant shall determine if any existing lighting equipment is located within the project limits and if so, what shall be removed from that system to accommodate the new lighting system.

The Consultant shall confirm with the Region or Local Area Municipality if any of the existing lighting equipment being removed is to be removed and salvaged or disposed of. If the equipment is to be salvaged, the Consultant shall obtain the location the equipment is to be delivered to and include the address and instructions for delivery in the specifications.

All luminaires being removed from existing hydro poles shall be coordinated with the local hydro authority. All loading removals shall also be provided to the local hydro authority to adjust billing.

2.13 Detailed Design

With the Hydro coordination underway and the lighting calculation approved by the Region, the Consultant can continue to prepare the complete lighting design package including drawings, specifications, and construction cost estimate.

Drawings to be included in the design package are as follows:

Drawings	Must Contain (as a minimum)
Legend and General Notes	<ul style="list-style-type: none"> - standard legend of symbols - custom project specific symbols - general installation and construction notes
Equipment Charts	<ul style="list-style-type: none"> - poles details: pole number, pole type, pole height, pole coordinates, footings, arm type, arm length, luminaire wattage, IES files, FAWS settings - junction box details: junction box number, coordinates - ground electrodes
Lighting Equipment Layouts	<ul style="list-style-type: none"> - power supply, footings, poles, arms, luminaires, ducts, ground electrodes, equipment tags
Wiring Diagrams	<ul style="list-style-type: none"> - proposed poles, arms, luminaires and junction boxes, equipment tags, circuit numbers, electrodes
Removals of Existing Lighting	<ul style="list-style-type: none"> - poles, arms, luminaires, junction boxes, power supplies, removal numbers, removals charts identifying equipment removal instructions
Installation Details	<ul style="list-style-type: none"> - Niagara Region standard details (as required) - project specific installation details (as required)

Specifications to be included in the design package are as follows:

Specifications	Must Contain (as a minimum)
General Specification	<ul style="list-style-type: none"> - operational constraints, contractor qualifications, details for Record (as-built) drawings, requirements for maintenance manuals, identification requirements of Subcontractors, Identification of equipment (labeling), layout requirements of poles and power supply locations, list of work items for Contractor and Region
Tender Items List	<ul style="list-style-type: none"> - list of all items with quantities and shall include identification of items being supplied by the Region
Special Provisions	<ul style="list-style-type: none"> - specifications for installation of each item - instruction to Contractor for equipment to pick up from the Region

Construction Cost Estimate	- unit prices for each item with total construction cost summary
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The Consultant shall prepare the complete lighting design package for review and acceptance by the Region.

2.14 Design Approval

The Consultant shall review and address all comments and markups provided by the Region and make a final submission of the complete document set including, Drawings, Specifications, Tender Items List and Cost Estimate for the Region's acceptance.

Once the Region has provided their acceptance of the design documents, the project is approved to move to the Tender and Construction stages.