Design Guidelines for Street Lighting

2016

The City of Calgary | P.O. Box 2100 Stn. M | Calgary, AB, Canada T2P 2M5 | calgary.ca

Table of Contents

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION TO LIGHTING DESIGN

This manual shall be the guiding principal for the design of roadway and roadway related lighting in the City of Calgary.

1.1 ABOUT THIS DOCUMENT

This manual provides the guidelines for the design of lighting installations within the City of Calgary road system. These lighting installations can include not only roadways, but also off-roadway facilities such as parking areas, sidewalks, pedestrian walkways and bikeways. The City Street Lighting Design Group ("The City") has standardized design criteria, lighting equipment, and construction methods for most of the installations throughout their jurisdiction.

This manual outlines the engineering standard practices that are to be employed for designing lighting systems that are under the jurisdiction of The City. This manual also provides basic details of the standard lighting equipment and materials used by The City. Specific and advanced details of the lighting equipment can be found in the City's Material Standards and Specifications. Construction methods and details for lighting systems can be found in the City's Standard Specifications for Street Lighting Construction.

This manual presents the recommended standard practices and design guidelines for roadway and related lighting systems. At all times, good engineering practices and sound engineering judgment shall be used in determining the required solutions for the lighting designs. The Senior Street Lighting Engineer will consider variations to these recommended practices.

1.2 PURPOSE OF ROADWAY LIGHTING

The principal purpose of roadway lighting is to produce a safe environment with accurate and comfortable vision along roadways at night and through tunnels during the day. However, roadway lighting serves different functions depending on the roadway type and area that is being illuminated. For example, lighting on a freeway or major highway is primarily for traffic flow and driver safety while lighting in a downtown or commercial area serves both vehicular traffic and pedestrians. Furthermore, much of the lighting in an urban or sub-urban area also compliments the commercial land use of the areas. In general, roadway lighting provides three specific functions:

- Vehicular Traffic - Lighting of the roadway provides visual guidance for the vehicular traffic thereby reducing night time accidents (and day time accidents in tunnels) and their associated human and economic costs.
- Personal Safety - Lighting provides an aid to police protection and enhances the sense of personal security. Proper night time vision also reduces the risk of pedestrian/vehicle accidents.
- Commercial Promotion - Lighting in a commercial area promotes business activities and the use of public facilities during night time hours.

1.3 ENGINEERING AND REFERENCE DOCUMENTS

These lighting design guidelines, as produced by The City, have been developed following engineering practices and design guidelines for roadway lighting and associated lighting systems. This manual references many other governing documents, which form the requirements for lighting design for the City of Calgary.

1.3.1 Required Standard Practice Documents

The following documents and manuals form the technical requirements for lighting design on Calgary roads. In order to undertake a proper engineering design for lighting systems, it is mandatory that all lighting designers must have access to, and refer to, the latest release of these manuals and documents, as produced by the Illuminating Engineering Society (IES) and the Transportation Association of Canada (TAC):

ANSI /IES RP-8	American National Standard Practice for Roadway Lighting
ANSI/IES RP-16	Nomenclature and Definitions for Illuminating Engineering
ANSI/IES RP-17	Recommended Practice for Airport Road Automobile Parking Area Lighting
ANSI/IES RP-19	Recommended Practice for Roadway Sign Lighting
ANSI/IES RP-20	Recommended Practice for Lighting for Parking Facilities
ANSI/IES RP-22	American National Standard Practice for Tunnel Lighting
ANSI/IES RP-33	Recommended Practice on Lighting for Exterior Environments
ANSI/IES TM-10	Addressing Obtrusive Light in Conjunction with Roadway Lighting
ANSI/IES TM-11	Light Trespass: Research, Results and Recommendations
TAC	Guide for the Design of Roadway Lighting
RTAC/ARTC	Illumination of Isolated Rural Intersections

1.3.2 Auxiliary Reference Documents

The following documents and manuals may be referred to for additional reference information pertaining to lighting systems. It is recommended that all lighting designers have access to, and refer to, the latest release of these manuals and documents.

ANSI/IES RP-7	Industrial Lighting
ANSI/IES DG-4	Design Guide for Roadway Lighting Maintenance
ANSI/IES DG-5	Recommended Lighting for Walkways and Class 1 Bikeways
ANSI/IES LM-50	Photometric Measurements of Roadway Lighting

	Installations
ANSI/IES LM-52	Photometric Measurements of Roadway Sign Installations
ANSI/IES LM-64	Photometric Measurements of Parking Areas
ANSI/IES LM-69	Interpretation of Roadway Luminaire Photometric Reports
ANSI/IES LM-71	Photometric Measurement of Tunnel Lighting Installations

1.3.3 Conflicting Recommendations

Conflicts between some requirements and recommendations provided by the IES and TAC may arise as documents are revised and updates are published. The requirements and recommendations provided in the manual with the latest publication date shall be taken as the most appropriate for use in preparing lighting designs.

1.3.4 Related Design Guidelines and Construction Standards

Further to the documents listed above, the lighting designers shall, where necessary, refer to and make use of the latest issues of the following City of Calgary design guidelines and construction standards:

- Design Guidelines for Subdivision Servicing
- Material Standards and Specifications, Street Lighting
- Standard Specifications, Street Lighting Construction
- Standard Specifications, Roads Construction

1.4 ELECTRICAL STANDARDS

All luminaires shall be Underwriters Laboratory of Canada (ULC), Canadian Standards Association (CSA) compliant, or Canadian Electrical Testing Laboratories (CETL) and bare the associated ULC, CSA, or CETL labels.

All circuits feeding the street lights shall be designed in accordance with the provision of Canadian Electrical Code (CEC), Part 1 (latest revision).

When calculating currents that will result in loads, expressed in watts or volt amperes, to be supplied by a low-voltage alternating current system, voltage divisor to be used shall be 120, 208, 240, and 480.

Voltage drop in an installation shall not exceed 5% from the supply side of the consumer's service to the point of utilization and not exceed 3% in a feeder or branch circuit. The demand on the load on a branch circuit shall be the connected load, if known. Otherwise it shall be 80% of the rating of the overload or over current device protecting the branch circuit, whichever is smaller.

1.5 BEFORE YOU BEGIN

This manual assumes the lighting designers have a sound knowledge of lighting design. Refer to the latest edition of the IES Lighting Handbook, as well as the

documents listed in Section 1.3 above, for information on lighting theory, design concepts, and terminology.

This manual does not include critical lighting design information such as classification definitions and design criteria. This required information is referenced to the appropriate IES Recommended Practice (RP), Design Guide (DG), or Technical Memorandum (TM) documents.

Lighting designers shall note that there are three separate design methods used for calculating roadway lighting levels and producing a roadway lighting design. Each of these three methods may produce different designs and different luminaire spacing and configuration, although each is acceptable engineering practice. These independent design methods are the Illuminance Method and the Luminance Method, each of which has a different set of design criteria and recommended values. All three of these methods are fully explained in the latest edition of the IES RP-8, American National Standard Practice for Roadway Lighting. The City will only accept designs performed using the Luminance Method and Illuminance Method. The appropriate application of the two different design methods utilized by The City is outlined in Section 4 of this manual.

Lighting designers are encouraged to utilize the most up to date design methods and techniques and the latest engineering applications in order to provide The City with the most cost effective solutions to lighting systems, while maintaining mandated minimum lighting levels and uniformity ratios. As such, The City, at its discretion, may direct the lighting designers to utilize specific lighting design methods, such as the Luminance Method or the Illuminance Method in order to be satisfied that the most up to date methods are employed.

2. LIGHTING WARRANTS

2.1 GENERAL

The City's policy is to minimize the amount of lighting required for a project while still maintaining the proper engineering requirements as recommended by IES and by TAC. Prior to starting any roadway lighting design the extent of the required lighting, and whether continuous, full or partial lighting is required, must be determined.

Lighting designers shall review all roadways in a project and determine their warrant status. This warrant status shall be reviewed and approved by The City prior to commencing the detailed design of the lighting systems.

Situations may occur where lighting is warranted but cannot be installed due to effecting conditions or circumstances (i.e. not economically feasible, physical obstruction by other services). The City will monitor these site situations on an ongoing basis and proceed with the installation of street lighting when they deem it appropriate.

2.2 DEFINITIONS

Continuous Lighting refers to lighting that runs continuously along a roadway or highway between intersections or interchanges.

Full Lighting refers to lighting covering a road, intersection or interchange in a uniform manner over the entire traveled portions of the roadway. Full lighting for an interchange may include continuous lighting along ramps and collector/distributor roads between sub-intersections within the interchange area.

Partial Lighting refers to the lighting of key decision areas, potential conflict points, and/or hazards in, and on the approach to, an intersection or interchange. Partial lighting may also guide a driver from one key point to the next, and (if sufficient luminaires are used) place a driver on a safe heading after leaving a lighted area.

Delineation Lighting is a special case of partial lighting used as sentry lighting that marks an intersection location for approaching traffic, or lighting that illuminates vehicles on a cross road.

2.3 WARRANTS

The lighting designers shall refer to the appropriate section in this manual (roadways, intersections, etc.) that describes the situations where The City considers lighting as being warranted.

Lighting for all other situations will be considered unwarranted and, if required or requested by a project, will be subject to negotiations with The City concerning ongoing operational and energy costs.

Underground Residential Distribution (URD): The City requires the design and installation of street lighting in all URD residential subdivisions

2.4 OTHER SITUATIONS REQUIRING LIGHTING

There may be other situations within a project where lighting is warranted on a special basis. Lighting designers shall confirm the need for lighting in these special situations with the Senior Street Lighting Engineer.

Special lighting systems may be required in areas with night time accident rates repeatedly above the critical rates as determined by a roadway safety audit.

3. LIGHTING DESIGN

3.1 DESIGN REQUIREMENTS

All lighting, warranted by The City, must meet the design criteria and the design requirements of the appropriate IES Recommended Practice (RP), Design Guide (DG), or Technical Memorandum (TM) documents.

3.2 CLASSIFICATION DEFINITIONS

Roadway Classifications which describe the general conditions of vehicular traffic interaction are detailed in IES RP-8 Section 2.0.

It should be noted that these classifications are the industry standards used by the lighting designers and are not necessarily the same as those used by Traffic Engineers and Municipal Planners, even though the classification names may be similar. The lighting designers shall classify all roads within a project using the IES classifications, and shall not apply traffic or municipal engineering definitions to the lighting design.

Pedestrian Walkway and Bikeway Classifications are detailed in IES RP-8 Section 2.1. Walkways and Bikeways are additionally classified in IES DG-5 Sections 2 and 3.

Land Use Classifications such as urban, suburban, and rural, are no longer formally used in lighting engineering. These terms may, however, be informally used in sections of this document.

Pedestrian Conflict Area Classifications which replace the Land Use Classifications used previously in lighting design methods, and which describe the vehicle/pedestrian interaction, are detailed in IES RP-8, Section 2.2.

Pavement Classifications are based on the pavement reflection characteristics of the CIE Four Class system. Pavement classifications are detailed in IES RP-8, Section 2.3 and in Table 1.

3.3 DAVIT STYLE VS HIGH MAST LIGHTING

3.3.1 Davit Style Lighting

Roadways are generally illuminated with flat glass cobra head luminaires mounted on davit luminaire poles.

The use of dropped lens style, non-cutoff luminaires is discouraged and may only be done with the authorization of the Senior Street Lighting Engineer.

3.3.2 High Mast Lighting

Generally The City does not accept the use of high mast lighting due to the increased capital and maintenance costs, energy efficiency and light trespass.

However, high mast lighting may be used in certain cases if it is shown to be cost effective.

Advantages of high mast lighting:

- May reduce glare, if the appropriate fixture is selected
- May improve uniformity
- May be installed at an early stage of construction and provide required detour and transition lighting
- Greater offset from traffic lanes, thus improving safety and reducing pole contact incidents

Disadvantages of high mast lighting:

- May result in additional light trespass on adjacent properties
- May result in unacceptable glare conditions
- May obstruct views from adjacent residential areas
- Requires pullouts for maintenance vehicles and for room to facilitate lowering and maintenance
- May not be as energy efficient as other lighting alternatives
- May have a greater light trespass than other lighting alternatives

Editions of IES RP-8, prior to RP-8-00 allowed for lower lighting levels if high mast lighting was used instead of conventional davit lighting. This option no longer forms part of current IES recommendations due to the lack of adequate research to justify lower levels and is not to be considered by the lighting designers.

For projects where high mast lighting is being considered, The City may require a cost/benefit analysis of high mast versus conventional davit lighting. The analysis should consider initial capital costs for materials and construction, as well as ongoing operational and maintenance costs over a 25-year period.

High mast lighting should be avoided in residential areas due to its higher potential for light trespass and glare onto adjacent properties. Where installing high mast lighting near residences, luminaire glare shields or louvers may be required to control light trespass and glare onto adjacent properties.

Consideration must always be given to the aesthetic affect that the high mast poles have on the background scenery. The lighting designers of a high mast lighting system must fully analyze the impact that the poles will have on views from strategic locations. This analysis must be formally documented and presented for review and discussion with The City.

3.4 DESIGN CRITERIA

Lighting designers shall determine, discuss, and confirm the required lighting design criteria with The City before proceeding with the lighting design. Table 1 is provided to assist the lighting designers in relating Subdivision Road Types to

Roadway Lighting Classifications. Drawings of the Subdivision Road Types, Road Classifications, and Cross Sections are provided in Appendix A.

Table 1: Subdivision Road Types to Roadway Lighting Classifications

Subdivision Road Type	Sheet #	Road Width (m)	Right of Way (m)	Median Width (m)	Posted Speed (kph)	Daily Traffic Volume	Roadway Lighting Classification
Skeletal Road – median 4 lane stage open shoulder	2	2 x 14.1	60	6	80 - 100	>30K	Expressway/ Freeway
Skeletal Road – median 4 lane stage curb & gutter	2	2 x 13.6	60	6	80 - 100	>30K	Expressway/ Freeway
Arterial Street – on street bike lanes – 4 lanes	3	2 x 9.5	36	6	50 – 60	20K-35K	Major
Arterial Street – multi-use pathway – 4 lanes	3	2 x 7.0	36	6	50 – 60	20K-35K	Major
Arterial Street – on street bike lanes – 6 lanes	4	2 x 13.0	46	9	50 – 60	20K-35K	Major
Arterial Street - multi-use pathway – 6 lanes	4	2 x 10.5	46	9	50– 60	20K-35K	Major
Industrial Arterial Street	8	14.4	30	N/A	50	10k-30k	Major
Local Arterial Street	10	2 x 9.3	32	3.5	50	15K-20K	Major
Parkway – with parallel pathway outside of right of way	12	2 x 9.1	36	6	50	20K-35K	Major
Parkway – without parallel pathway outside of right or way	12	2 x 9.1	36	6	50	20K-35K	Major
Urban Boulevard – bike lane and parking in each direction	14	2 x 12.0	42.6	3.5	50	17.5K-25K	Major
Urban Boulevard – bike lane in each direction, no parking	14	2 x 9.1	36	3.5	50	17.5K-20K	Major
Neighborhood Boulevard – 2 lanes with bike lanes and parking	17	15.4	30	N/A	50	12.5K-22.5K	Major
Neighborhood Boulevard – 4 lanes with parking and no bike lanes	17	17.4	30	N/A	50	12.5K-22.5K	Major
Primary Collector Street – 2 lanes divided with bike lane and parking	20	2 x 7.7	29.0	3.5	50	8K-15K	Collector
Primary Collector Street – 4 lanes divided with bike lane and no parking	20	2 x 8.3	30	3.5	50	8K-15K	Collector
Collector Street – 2 lanes with bike lanes on both sides and parking on one side	23	12.3	22.5	N/A	50	2K - 8K	Collector
Collector Street – 2 lanes with bike lanes and parking on both sides	24	15.0	25.2	N/A	50	2K – 8K	Collector
Collector – 2 lanes with parking on both sides and no bike lanes	24	10.8	21.0	N/A	50	<3K	Collector
Activity Centre street	31	15.4	26.0	N/A	50	3K – 15K	Collector

Industrial Street	32	9.0	19.0	N/A	50	3K – 12K	Collector
Residential Entrance Street – with frontage	37	2 x 6.5	23.5	3.5	50	≤2K	Local
Residential Entrance Street – no frontage	37	2 x 6.0	22.5	3.5	50	≤2K	Local
Residential Street 'M'	38	8.5	16.0	N/A	50	≤2K	Local
Residential Street 'M – L'	39	9.0	16.0	N/A	50	≤2K	Local
Residential Street 'SW – L'	40	9.0	18.4	N/A	50	≤2K	Local

Note: Subdivision Road Types based on Design Guidelines for Subdivision Servicing, 2014.

All design criteria for roadway lighting systems are based on the appropriate IES Recommended Practice (RP), Design Guide (DG), or Technical Memorandum (TM) documents.

All design criteria, as recommended by the appropriate documents, shall be met for a lighting system, including but not limited to:

- Lighting levels (for Luminance Method and/or Illuminance Method)
- Uniformity ratios
- Veiling luminance (glare)
- Obtrusive light (sky glow and light trespass) criteria as set out in this manual in Section 5 – Obtrusive Light and Light Pollution

3.4.1 Luminance Criteria

The Luminance Method of roadway lighting design determines how "bright" the road is by determining the amount of light reflected from the pavement in the direction of the driver. Lighting designers shall meet the luminance criteria set forth in Table 2: Luminance Criteria for Roadways and Interchanges.

3.4.2 Illuminance Criteria

The Illuminance Method of roadway lighting design determines the amount of light incident on the roadway surface from the roadway lighting system. The amount of light seen by the driver is the portion that reflects from the pavement towards the driver. Lighting designers shall meet the illuminance criteria set forth in Table 3: Illuminance Criteria for Roadways and Interchanges.

3.4.3 Pedestrian Activity

Within the Roadway Lighting Classifications, major, collector, and local street classifications appropriately describe general conditions of vehicular traffic conflict

in urban areas. However, a second type of conflict, which is responsible for a disproportionate number of night time fatalities, is the vehicle/pedestrian interaction. The magnitude of pedestrian flow is always related to abutting land use. Three classifications of pedestrian night time activity levels and the types of land uses with which they are typically associated are given below:

- High – Areas with significant numbers of pedestrians expected to be on the sidewalks or crossing the streets during darkness. Examples are downtown retail areas, near theaters, concert halls, stadiums, and transit terminals.
- Medium – Areas where lesser numbers of pedestrians utilize the streets at night. Typical are downtown office areas, blocks with libraries, apartments, neighborhood shopping, industrial, parks, and streets with transit lines.
- Low – Areas with very low volumes of night pedestrian usage. These can occur in any of the cited roadway classifications but may be typical of suburban streets with single family dwellings, very low density residential developments, and rural or semirural areas.

The choice of the appropriate pedestrian activity level for a street is an engineering decision. If needed, one hour pedestrian counts can be taken during the first hour of darkness on three selected days, to establish the estimated average pedestrian traffic counts. A section of typical land use can be sampled by counting one or two representative blocks, or a single block of unusual characteristics can be counted, perhaps at a different hour, such as discharge from a major event. The volume of pedestrian activity during the hour of count that warrants increased lighting levels is not fixed and represents a local option. Guidelines for possible local consideration are:

- High – over 100 pedestrians/hour
- Medium – 1 to 100 pedestrians/hour
- Low – 10 or fewer pedestrians/hour

These volumes represent the total number of pedestrian walking in both directions in a typical block or 200 meter section.

Table 2: Luminance Criteria for Roadways and Interchanges				
Roadway Lighting Classification	**Pedestrian Activity**	**Average Luminance Cd/m^2**	**Uniformity Ratio (E_{avg}/E_{min})**	**Veiling Luminance Ratio (Lvmax/Lavg)**
Highway / Expressway	High	≥ 1.0	≤ 3.0	≤ 0.3
	Medium	≥ 0.8	≤ 3.0	≤ 0.3
	Low	≥ 0.6	≤ 3.5	≤ 0.3
Partial Lighting of Interchange/ On/Off Ramps		≥ 0.6	≤ 3.5	≤ 0.3
Major		≥ 1.2	≤ 3.0	≤ 0.3
	Medium	≥ 0.9	≤ 3.0	≤ 0.3
	Low	≥ 0.6	≤ 3.5	≤ 0.3
Collector	High	≥ 0.8	≤ 3.0	≤ 0.4
	Medium	≥ 0.6	≤ 3.5	≤ 0.4
	Low	≥ 0.4	≤4.0	≤ 0.4
Local/ Alleyway	High	≥ 0.6	≤ 6.0	≤ 0.4
	Medium	≥ 0.5	≤ 6.0	≤ 0.4
	Low	≥ 0.3	≤ 6.0	≤ 0.4

Table 3: Illuminance Criteria for Roadways and Interchanges				
Roadway Lighting Classification	**Pedestrian Activity**	**Illumination Level Required (lux/fc)**	**Uniformity Ratio (E_{avg}/E_{min})**	**Veiling Luminance Ratio (Lvmax/Lavg)**
Freeway / Expressway	High	14.0/1.4	3.0	0.3
	Medium	12.0/1.2	3.0	0.3
	Low	9.0/0.9	3.0	0.3
Major	High	17.0/1.7	3.0	0.3
	Medium	13.0/1.3	3.0	0.3
	Low	9.0/0.9	3.0	0.3
Collector	High	12.0/1.2	4.0	0.4
	Medium	9.0/0.9	4.0	0.4
	Low	6.0/0.6	4.0	0.4
Local	High	9.0/0.9	6.0	0.4
	Medium	7.0/0.7	6.0	0.4
	Low	4.0/0.4	6.0	0.4

3.5 HORIZONTAL ILLUMINANCE FOR SIDEWALKS

Many roadways have adjacent sidewalks with the road allowance. Table 4: Recommended Values for Pedestrian Areas includes recommended maintained average horizontal illumination levels and uniformity ratios for high, medium, and low pedestrian activity. This level of lighting assists drivers and pedestrians in the undertaking the following activities:

- Detection of obstacles or hazards
- Perception of movements and intentions of others
- Reading of signs and building numbers
- Recognition of landmarks, bus stops, street furniture, parked vehicles, curbs and other features

Where the sidewalk is separated from the roadway by a distance greater than 5.0m, the facility should be classified as an off-roadway and lighted as a walkway and bikeway.

Pedestrian level lighting should be mounted at a height of 3.0 – 6.0 m.

Table 4: Recommended Values for a Sidewalk

Pedestrian Activity	Maintained Average Horizontal Illuminance (lux)	Average- Minimum Horizontal Uniformity Ratio
High	≥ 20.0	≤ 4.0
Medium	≥ 5.0	≤ 4.0
Low	≥ 3.0	≤ 6.0

Sidewalk lighting may be required at the discretion of the Street Light Coordinator

4. LIGHTING DESIGN CALCULATIONS

4.1 DESIGN AND CALCULATION

Lighting designs and calculations for roadways, walkways, tunnels, and open areas can use different methods as appropriate for the specific situations. The design and calculation methods appropriate for specific lighting situations are outlined in the IES document relating to the situation (roadways, tunnels, etc.)

4.2 LIGHTING DESIGN AND CALCULATION METHODS

All lighting design calculations must be prepared using AGI32 roadway lighting design software and submitted to The City for review. Section 16 of this manual describes design calculations submission requirements.

The City recommends two distinct design and calculation methods for roadway lighting. These methods are the Illuminance Method and the Luminance Method:

- Illuminance Method - determines the amount of light incident on a surface from a roadway lighting system.
- Luminance Method - determines the amount of reflected light from the pavement in the direction of the driver. It determines how “bright” the road is.

It is the requirement of The City that at least one of these lighting designs and calculation methods be used to meet the required design criteria for a city roadway lighting project. However, it is not required that both design calculation methods be employed to demonstrate that the design criteria have been met.

The different design and calculation methods may produce different lighting designs and layouts for the same project. Furthermore, one method of lighting design is not always more efficient than another; different design and calculation methods suit different road geometrics. As such, the lighting designers should select the most appropriate design and calculation method to produce the most energy efficient lighting design.

The lighting designers should refer to IES RP-8 Annex B Calculation and Measurements for design suggestions and comparisons of the different design methods. The lighting designers should pay particular attention to the system changes and modifications that can be employed and their effect on pavement luminance.

The following recommendations are made to aid in determining the best method for a roadway lighting design:

- Small roadway lighting projects - such as isolated intersections and isolated conflict areas, can be adequately designed using the Illuminance Method. The Luminance Method can be employed at the lighting designers’ discretion.

- Medium sized roadway lighting projects - which include straight sections of roadway with continuous lighting and intersections of higher complexity, should be designed using the Illuminance Method and Luminance Method, with the most energy efficient design selected.
- Large roadway lighting projects - will require a design by both methods with the most energy efficient design selected.

URD RESIDENTIAL SUBDIVISIONS: All street lighting calculations for URD residential subdivisions shall be done using luminance and/or illuminance design methods. STV methodology shall not be applied

Lighting design using the Luminance Method is an iterative process and, unlike the Illuminance Method, cannot be calculated directly. The following design process is suggested for designing medium to large roadway lighting projects:

1. Select the appropriate luminaire wattage and pole height;
2. Determine the appropriate illuminance design criteria;
3. Calculate the pole spacing using the Illuminance Method;
4. Evaluate the design in terms of luminance design criteria;
5. Modify the design and reiterate the process to achieve the luminance criteria.

4.3 COMPUTER PROGRAMS FOR LIGHTING DESIGN

All lighting calculations shall be prepared using AGI32 roadway lighting design software. The design file shall be submitted electronically.

When lighting calculations are being performed, lighting designers shall use the luminaire manufacturer's IES formatted photometrics for the lighting calculations. IES formatted photometrics are generally provided in digital file by the luminaire manufacturer upon request. Pre-approved manufacturers' photometric file numbers are shown on the City's Pre-approved Products List. For a copy of the City's Pre-approved Products List, contact The City Street Light Design Team.

The IES formatted photometrics for the luminaire(s) used shall be provided electronically with the project design file(s).

4.4 LIGHT LOSS FACTORS

4.4.1 LED Light Loss Factors

Lighting calculations shall be performed using the initial rated lamp lumens and the total Light Loss Factor (LLF) for LED fixtures. Calculations for maintained LED values are determined as follows:

Light Loss Factor (LLF) where LLF = LLD x LDD x LATF, and

- Lamp Lumen Depreciation (LLD) shall be determined by the manufacturer and be based on the percentage of initial output at 88,000 operating hours calculated in accordance with IES LM-80 and TM-21. The TM-21 extrapolation can however be up to 14 times
- Luminaire Dirt Depreciation (LDD) = 0.90, as per IES DG-4 for an enclosed and gasketed roadway luminaire installed in an environment with less than 150 µg/m³ airborne particulate matter and cleaned every ten years
- Luminaire Ambient Temperature Factor (LATF) = 1.04 (+10° C) (shall be confirmed by the supplier)

4.4.2 HID Light Loss Factors

Lighting Calculation shall be performed using the initial rated lamp lumens and the total light loss factor (LLF). Lamp lumen values for the standard City Pre-approved HID lamps may be found in the appropriate lamp manufacturer's catalogue. Total LLF and their components vary depending on the area and the objects to be lighted and are outlined in the appropriate IES document for the facility under design.

The City has standardized the LLF for HID fixtures that must be used in all roadway lighting calculations and they are outlined in Table 5.

Table 5: Light Loss Factors for HID Fixtures

Area	Lamp Lumen Depreciation (LLD)[3]	Luminaire Dirt Depreciation (LDD)[3]	Luminaire Component Depreciation (LCD)[4]	Equipment Factor (EF)[5]	Total Light Loss Factor (LLF)
General [1]	0.88	0.88	0.98	0.97	0.74
Special [2]	0.88	0.82	0.98	0.97	0.69

[1] This is the default classification and will be used in the majority of the city

[2] Typically areas with heavy industrialization

(This classification is rarely used and applies only to very few heavily industrialized areas in the city. Furthermore, these industrial areas must be producing a significantly high level of airborne particulate matter. This classification may only be used if confirmed with The Senior Street Lighting Engineer)

[3] Based on a 4 year maintenance cycle in residential areas.

[4] Degradation of the reflector and refractor.

[5] Effect of ambient temperature, voltage fluctuations, and the ballast and lamp factors.

4.5 CALCULATION AREA

A calculation grid shall define the extents of the calculation area. The calculation grid shall be determined by application of the principals outlined in IES RP-8 Annex A, Section A9 Selection of Grid for Calculation and Measurement. The extents of the calculation shall be as defined in Figure 1.

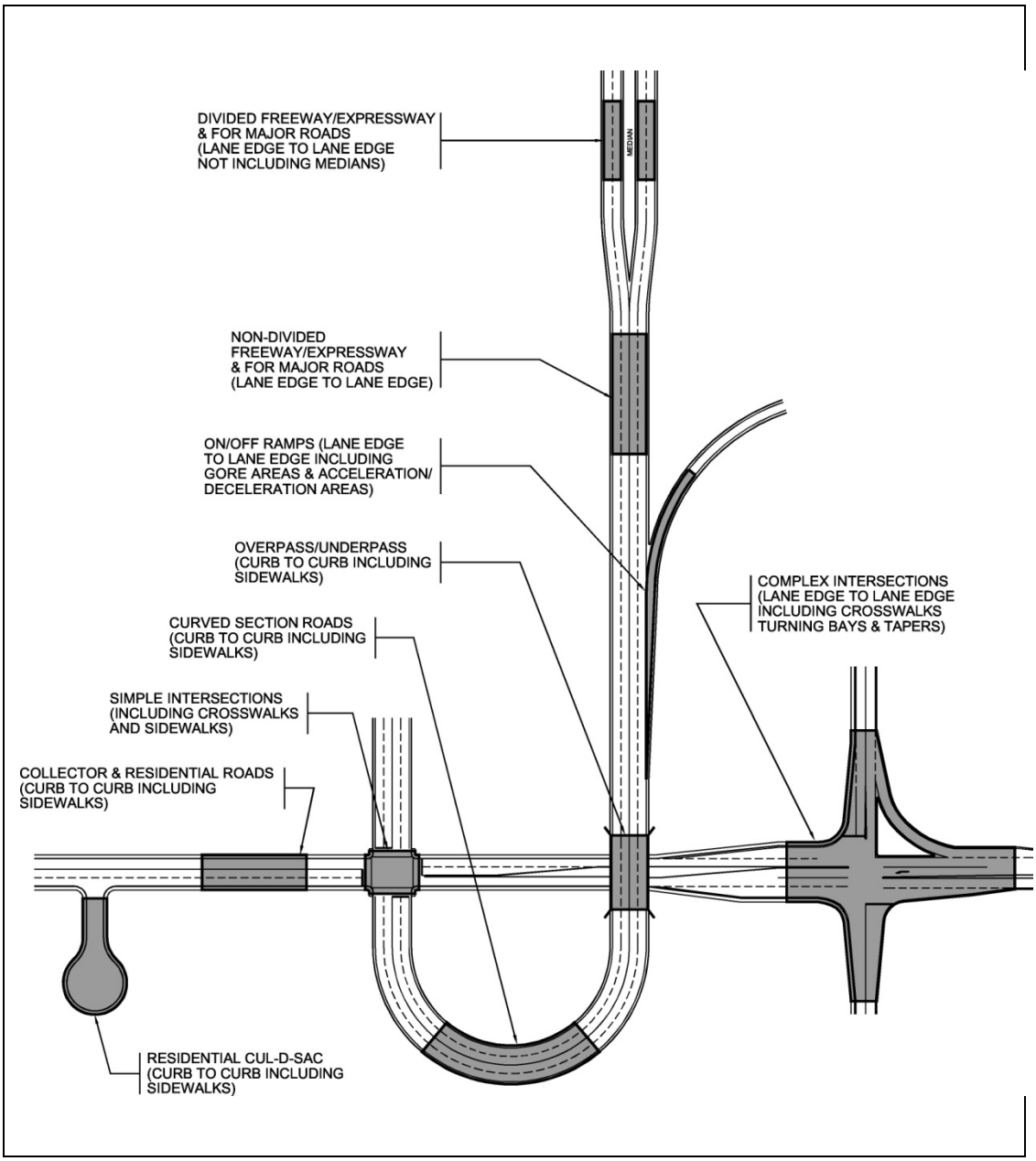


Figure 1: Illumination Calculation Areas

5. OBTRUSIVE LIGHT AND LIGHT POLLUTION

5.1 INTRODUCTION

Obtrusive Light, sometimes referred to as Light Pollution, has become a common concern of the general public. Light pollution not only detracts from the enjoyment of the night time setting, but also has been shown by recent research to have negative effects on biological systems. Furthermore, most light pollution is the result of light not directed specifically at the area of consideration and, therefore, can be considered as wasted light. All wasted light is also wasted energy. Therefore the reduction of light pollution will typically lead to the increased energy efficiency of the lighting design.

Light Pollution can be classified into three categories:

- Light Trespass - can be described as the effect of light that strays from the area it is intended to illuminate and becomes an annoyance, a nuisance or a detriment to visual performance. IES TM-11-00 (R2011) Light Trespass: Research, Results, and Recommendations, provides guidelines on the limitations for light trespass.
- Sky Glow - is the result of stray light being scattered in the atmosphere, resulting in added “sky brightness”. One method to limit sky glow is to limit the amount of light directed towards the sky. This includes limiting the amount of total light used in an area, and limiting the amount of total light used in an area, limiting uplight form luminaires. See CIE (Commission Internationale de L’Eclairage) Report 126, 1997, Guidelines for Minimizing Sky Glow for more guidance).
- Glare - can be described as unwanted source luminance, is defined by the IES as “the sensation produced by luminance in the visual field that is sufficiently greater than the luminance to which the eye has adapted to cause annoyance, discomfort, or loss of visual performance and visibility”.

The criterion used for roadway lighting to address disability glare is limiting the veiling luminance ratio of a lighting system.

Refer to IES RP-8, Annex C for a more detailed definition of glare, glare assessment methods and glare reduction methodology.

5.2 LEGISLATION

No legislation has been enacted in the Province of Alberta, or by the federal government of Canada, which relate to the requirements of designing lighting systems with respect to light pollution.

Several either formal, or ad-hoc, committees have been formed with the goal of having legislation enacted in Canada to control light pollution. Lighting designers shall keep abreast of developments in light pollution legislation and shall adhere to such legislation when they are enacted.

5.3 DESIGN RECOMMENDATIONS

With the absence of legislation relating to obtrusive light and light pollution, The City has developed the following recommendations that shall be adhered to when developing a lighting design. These recommendations may be applied to certain projects as specific requirements at the determination of the Senior Street Lighting Engineer.

All lighting systems shall be designed to minimized light pollution as outlined in the following IES publications:

- IES RP-8, Annex C: Glare contains a more detailed definition of glare and provides useful information and methodology for glare assessment and glare reduction
- IES TM-10: Addressing Obtrusive Light (Urban Sky Glow and Light Trespass) in Conjunction with Roadway Lighting

  This Technical Memorandum identifies some of the aesthetic, environmental and energy management issues associated with obtrusive light and suggests lighting design solutions
- IES TM-11: Light Trespass: Research, Results, and Recommendations

  This Technical Memorandum provides recommendations for measuring light trespass and, while not specific to roadway lighting, provides background information helpful in the application of IES TM-10

In certain circumstances, and in special geographical areas, light pollution may be considered as a specifically important factor in the design development. In these special cases, as determined by the Senior Street Lighting Engineer, lighting designs shall be designed to minimized light pollution as outlined in IES RP-33 Recommended Practice on Lighting for Exterior Environments.

The City requires that all new street lighting designs adhere the policy of using low glare street lighting luminaires in accordance to the EnviroSmart Streetlights Program, developed in 2005. This program was City Council approved and is deemed to set the standard for compliance with the City's "low glare and spill light" design requirements for street lighting systems.

URD RESIDENTIAL SUBDIVISIONS: Lighting systems in URD residential subdivisions shall be computer designed using City standard LED luminaires to minimize glare and spill light. The same principals of design relative to minimizing glare and spill light shall apply when designing lighting systems in URD residential subdivisions using City approved decorative luminaires

6. STREET LIGHTING MATERIALS

6.1 STANDARD LIGHTING EQUIPMENT

The lighting designers are advised that The City supplies all poles, luminaires lamps and related materials for roadway lighting installations. For a complete listing of the roadway lighting equipment and materials supplied by The City, please contact The City Street Light Design Team..

For a complete listing of all City pre-approved street lighting luminaires, please refer to The City Street Light Design Team.

In general, luminaire voltages shall be as defined in Table 6 below:

Table 6: Luminaire Connection Voltages

Streetlight System Service Voltage	Luminaire voltage	Location Used	Service Type
120/240v 1ph 3w, 120/208v 3ph 4w or 240/480v 1ph	120v, 208v, 240v or 480vg	Major Roads Projects	Service Cabinet or Panel
120/208v 3ph 4w	208v	Specific Networks	30 amp Control Unit, Service Cabinet or Panel
240v 1ph 2w	240v	Residential Subdivisions	30 amp PER Control Unit

All lighting equipment to be used on City projects must be City pre-approved. Although The City has standardized on its lighting equipment, the equipment specifications may change from time to time. A current copy of the Material Standards and Specifications, Street Lighting may be purchased from The City Street Light Design Team..

6.2 HIGH MAST LIGHTING EQUIPMENT

Refer to the Material Standards and Specifications, Street Lighting for high mast lighting equipment specifications.

Standard high mast lighting structures are generally one of two types:

- 30.0m high poles with either three or four fixed-ring mounted luminaires - an internal power distribution panel is located inside the handhold of each pole. This pole is not stocked in the City stores and must be ordered in the quantities required on a per project basis.
- 30.0m high poles with either three or four lowering-ring mounted luminaires - the luminaire-mounting ring is supported by two cables and is raised and

lowered by a single or double drum winch located inside the pole hand hole. An integral or portable drive motor drives the winch. An internal power distribution panel is located inside the handhold of each pole. This pole is currently not available from City stores.

The lighting designers may consider custom mounting heights and alternate luminaire types. All high mast lighting equipment must be approved by the City Senior Street Lighting Engineer.

6.3 SPECIALTY LIGHTING EQUIPMENT

Non-standard specialty lighting equipment shall be selected to suit the project requirements. Specialty materials are not covered by the City pre-approval process and must be approved for use by the City Senior Street Lighting Engineer on a project-by-project basis. This equipment typically includes, but is not limited to, the following:

- Decorative post top poles and luminaires
- High mast luminaires
- Vehicular tunnel luminaires

Where non-standard lighting equipment is specified, it shall be of the highest standard and quality. Non-standard equipment must be readily available and easy to maintain, and all products of a similar nature must be of a single manufacturer. The use of custom products shall be avoided as they can cause maintenance problems. Where custom products cannot be avoided, lighting designers shall ensure that spare parts are supplied to The City in quantities determined by the City Senior Street Lighting Engineer, as part of the project requirements.

When using non-standard luminaires, lighting designers shall undertake the lighting design using a computer lighting program. The luminaire manufacturers must provide IES format photometrics for use with a computer lighting design program. Computer lighting calculations and designs shall be submitted to the City Senior Street Lighting Engineer for review and approval.

Some of the ideal poles and luminaires would include:

- Backlight and glare rating no greater than 2
- 1-3G vibration rated
- Photocell receptacle should be NEMA c136.41 (5 pin or 7 pin with dimming ability on the drivers)
- Surge protection to TAC standards

There are minimaum specifications that must be met when choosing specialty lighting luminaire’s and poles.

6.3.1 Specialty Pole requirements

Pole requirements are as follows:

- 10 year factory warranty with a life cycle of 50 years
- Galvanized steel, powder coated galvanized steel or stainless steel are to be used in all installations.
- CSA label applied to the pole. The pole should adhere to class # 3426-03 luminaires - luminaires poles and (CSA 22.2, CSA G164/ASTM A123, CSA W59, W47.1)
- Provide engineered shop drawings showing max fixture weight and effective projected area); mounting height of banners, signs, wind load to be designed to 1/25 year wind

6.3.2 Specialty Luminaire Requirements

The luminaire requirements are as follows:

- Provide the IES file to the street light design team
- CSA or CUL luminaire certification (certification is UL1598)
- Temperature rated to -40 degrees celcius to +40 degrees celcius
- Zero uplight
- IP 66 rated
- Luminaires to have a 10 year warranty with a stated lifespan of twenty years (100,000 hours)

6.4 RECYCLING AND WASTE MANAGEMENT

6.4.1 Material for recycling should be delivered to at the following address:

Westcan Recycer Ltd.
8919 68 Street NE
Calgary, Alberta

6.4.2 Steel and aluminum poles removed from any site must be disposed of at a metal recycling facility. The Contractor should submit a recommended recycling facility to The City for approval prior to disposal.

7. ROADWAY LIGHTING

7.1 GENERAL

This section, and the terminology used, applies to the sections of roadways between intersections and/or interchanges. In general, the City of Calgary requires continuous lighting on all new and upgraded roadways.

7.2 ROADWAY LIGHTING WARRANTS

Continuous lighting is required between intersections or interchanges in the following situations:

a) Urban Areas

- All freeways and expressways
- All roadways, excluding back lanes and alleys, in urban area central business districts
- All roadways, excluding back lanes and alleys, in general urban areas
- Back lanes and alleys in general urban areas if the crime rate or incidents of social disorder are significantly high as determined by the public safety authorities
- Back Lanes shall be light in accordance with local roadway lighting requirements if the back lane is the primary access to the residence. Concrete filled bollards are required for protection of these poles.

b) Suburban Areas

- All freeways
- All expressways
- All roadways, excluding back lanes or alleys

c) Rural Areas

- Undeveloped rural areas may or may not have installed lighting. Street lighting shall be required at the time of roadway upgrading or the development of adjacent lands
- Areas with night time accident rates repeatedly above the critical rates as determined by a roadway safety audit shall require lighting

7.3 ROADWAY LIGHTING MATERIALS

All street lighting systems shall be designed using City pre-approved materials.

For a current listing of all City pre-approved street lighting poles, luminaires and lamps refer to The City Street Light Design Team.

For a complete listing of the roadway lighting equipment and materials pre-approved and supplied by The City, refer to The City Street Light Design Team.

7.4 ROADWAY LIGHTING DESIGN

- Illuminance Method - recommended roadway lighting design criteria using the Illuminance Method are detailed in Section 3.4 Table 2.
- Luminance Method - recommended roadway lighting design criteria using the Luminance Method are detailed in Section 3.4 Table 3.

URD RESIDENTIAL SUBDIVISIONS: All street lighting calculations for URD residential subdivisions shall be done using the Illuminance design methods. Luminance may be used at the discretion of the Street Lighting Coordinator. STV methodology shall not be applied.

Guidelines for selecting and matching standard luminaire mounting heights and wattages for various road types are described in Table 7 below.

Table 7: Luminaire Mounting Heights and Wattages for Various Road Types

ROAD TYPE	POLE HEIGHT	HPS LUMINAIRE WATTAGE	LED LUMINAIRE WATTAGE
1 - 3 lane roads (Total of all traffic lanes)	9 m 9 m	100W HPS 150W HPS	45W – 60WLED 60W - 90W LED
4 - 6 lane roads (Total of all traffic lanes)	15 m 15 m 20 m	310W HPS 400W HPS 400W HPS	100W – 150W LED 150W – 225W LED 225W – 275W LED
7 - 8 lane roads (Total of all traffic lanes)	20 m 20 m	400W HPS 750W HPS	225W – 275W LED 275W – 500W LED
Freeway and expressway acceleration and deceleration lanes, ramps, and tapers	9 m 15 m 20 m	100/150/200W HPS 400W HPS 1000W HPS	45W – 90W LED 150W – 225W LED 275W – 500W LED

Lighting designers shall select the most cost effective luminaire wattage and mounting height to suit the road width, in accordance with Table 7.

Prior to selecting the luminaire mounting height, lighting designers shall accurately determine the height of any overhead power lines that may be in conflict with the luminaire poles. The lighting designers shall also confirm the required power line clearances with the local utility company. Designs shall maintain the minimum clearances required between luminaire poles and power lines as outlined in Figure 8.

Where utility poles are being relocated due to road construction, lighting designers shall confirm that the minimum clearances outlined in Figure 8 are maintained. This may require the utility company installing taller poles to accommodate the required luminaire pole mounting heights. Lighting designers shall coordinate the required power line heights with the utility company by working with the utility company design personnel and shall confirm clearance requirements with the Alberta Electrical and Communication Utility Code (AECUC).

Where power poles are not being relocated, and overhead lines are in conflict with the proposed luminaire poles, lighting designers shall consider the following options:

- One-sided lighting (on the road side opposite to the overhead utility lines) using taller luminaire davit poles
- Utility company raising the power lines
- Obtain a cost estimate from the utility company
- Custom luminaire arm brackets
- Shorter luminaire davit poles
- Post top luminaires on very short poles
- 2.4m luminaire sweeps mounted on the utility poles. It is The City's preference that street lighting be installed on standalone luminaire davit poles, not on utility poles. The installation of street lighting on utility poles shall only be considered as a "last resort" option, and must be approved by the City Senior Street Lighting Engineer.

The best option is often the use of one-sided lighting with taller poles. Installing luminaire sweeps on the utility poles is the least preferred option and should be avoided whenever possible. After reviewing all options, lighting designers shall select the most cost-effective option and then obtain approval from the City Senior Street Lighting Engineer.

7.5 ROADWAY LIGHTING LUMINAIRE LAYOUT

Where continuous lighting is required between intersections, the luminaire poles shall be positioned in a one-sided spacing, an opposite spacing, a staggered spacing, or a median spacing as illustrated in Figure 2.

The pole locations at intersections, as defined in Section 8 shall take priority in a lighting design. The luminaire pole spacing between intersections shall be designed and altered to suit the preferred locations of luminaire poles at the intersections.

When spacing luminaire poles between intersections, lighting designers shall measure the distance from the near side of each intersection, then calculate and determine the optimum spacing that will be required to achieve the proper lighting levels and to provide a consistent spacing of the luminaire poles.

The spacing distance shall be changed in a smooth transition over several pole cycles for roadways that change width or change required lighting levels. For

example, if the spacing distance must change from 40m to 60m (due to the narrowing of the roadway), it is advisable to change in increments of 5m.

The optimum pole spacing, as calculated to meet the theoretical design criteria, may not suit an even or consistent spacing between intersections. The lighting designers shall use good engineering judgment to either compress or stretch out the theoretical pole spacing so that even and consistent pole spacing is achieved.

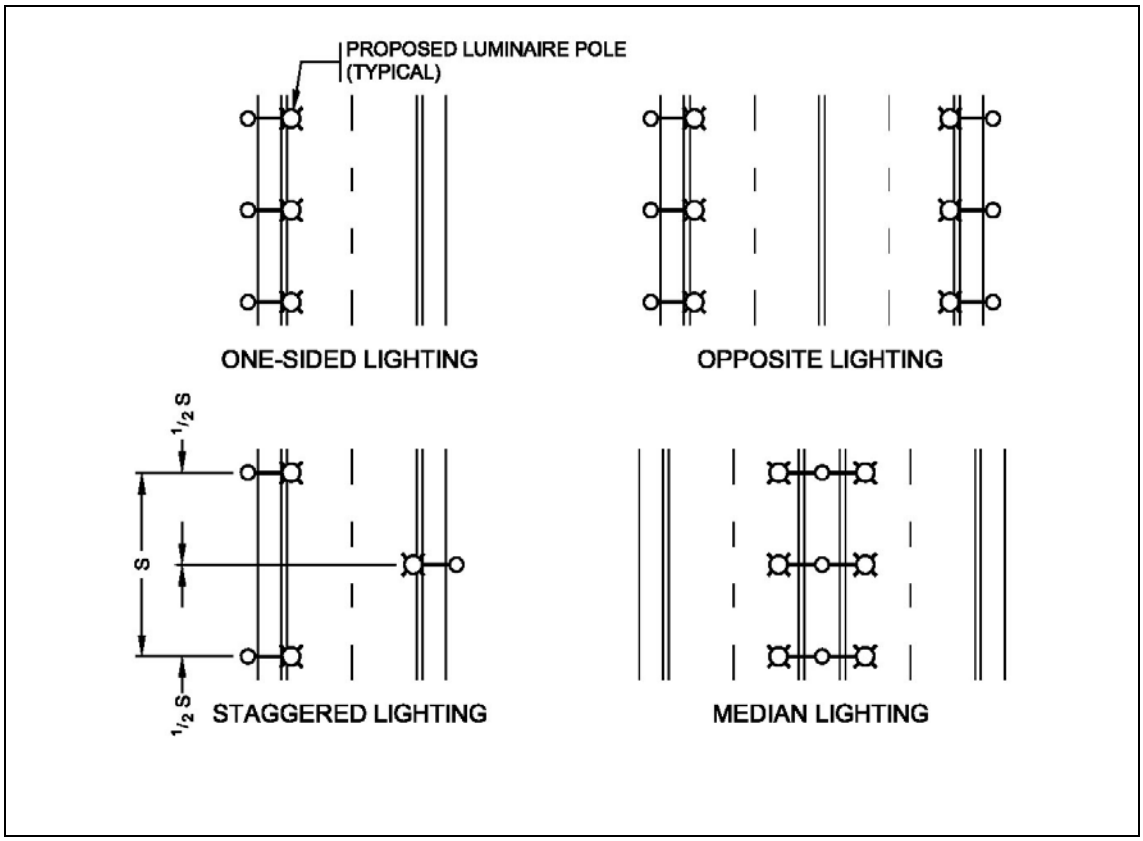


Figure 2: Typical Davit Luminaire Pole Layouts

Davit luminaire pole layout configurations shall be applied at the discretion of the Lighting Designer, but may be pertain to the following examples:

- Opposite or staggered lighting is generally used on all Local and Collector roads and three lanes or wider (total of all traffic lanes).
- One sided lighting may be used if it can meet lighting levels.
- Median lighting is generally used on roads that have either wide medians or concrete centre barrier.

URD RESIDENTIAL SUBDIVISIONS: Roadway lighting systems in URD residential subdivisions shall be designed with luminaire pole configurations as follows:

- One-sided or staggered configuration on all Local roads
- Staggered or median mounted configuration on all Collector roads

Pole layouts are open to the discretion of the lighting designer.

The lighting designers shall investigate the possibility of future road widening. If road widening is planned for within a reasonable timeframe, then the lighting design should be consistent with the ultimate design required in the future. A reasonable timeframe can be considered as five years or sooner. The lighting designers shall confirm the possibility of future road widening with the City's Transportation Planning Business Unit.

Refer to Figure 24, Section 12 – Under/Overpass and Tunnel Lighting for typical davit luminaire pole locations around underpasses, overpasses, and tunnel structures. Spacing luminaires in optimum locations is critical to achieving proper lighting under these structures.

High mast luminaire poles shall be located well clear of the roadway to reduce hazards and allow for easy maintenance. In no case shall high mast poles be located closer than 15.0m from the edge pavement. When locating high mast poles, ensure they will be easily accessible to maintenance vehicles. Pullouts and working areas for the maintenance vehicles may be required.

7.5.1 Luminaire Poles on Curved Roads

Where possible, for safety reasons, davit luminaire poles shall be placed on the inside of curves as shown in Figure 3 below if concrete roadside barrier is not present or proposed. This is only permissible if one-sided lighting produces acceptable illumination results. Alternate pole locations on the outside of curves shall only be used when special permission is granted by The City.

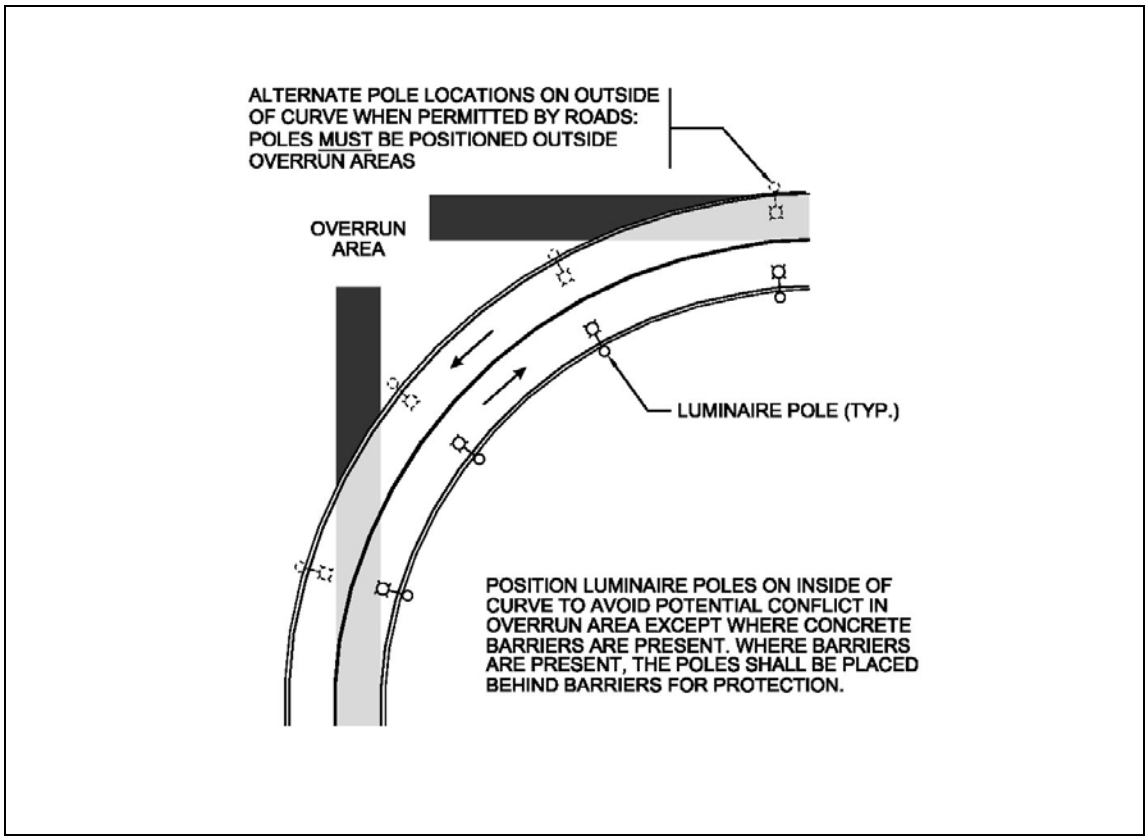


Figure 3: Location of Luminaire Poles on Curved Roads

7.5.2 Luminaire Poles at Driveways

Luminaire poles located beside driveways shall be positioned such that the minimum clearances defined in Figure 4 below are maintained. Should physical constraints at the site not permit the required clearance to be maintained, approval of the reduced clearance to the driveway shall be obtained from the City Senior Street Lighting Engineer.

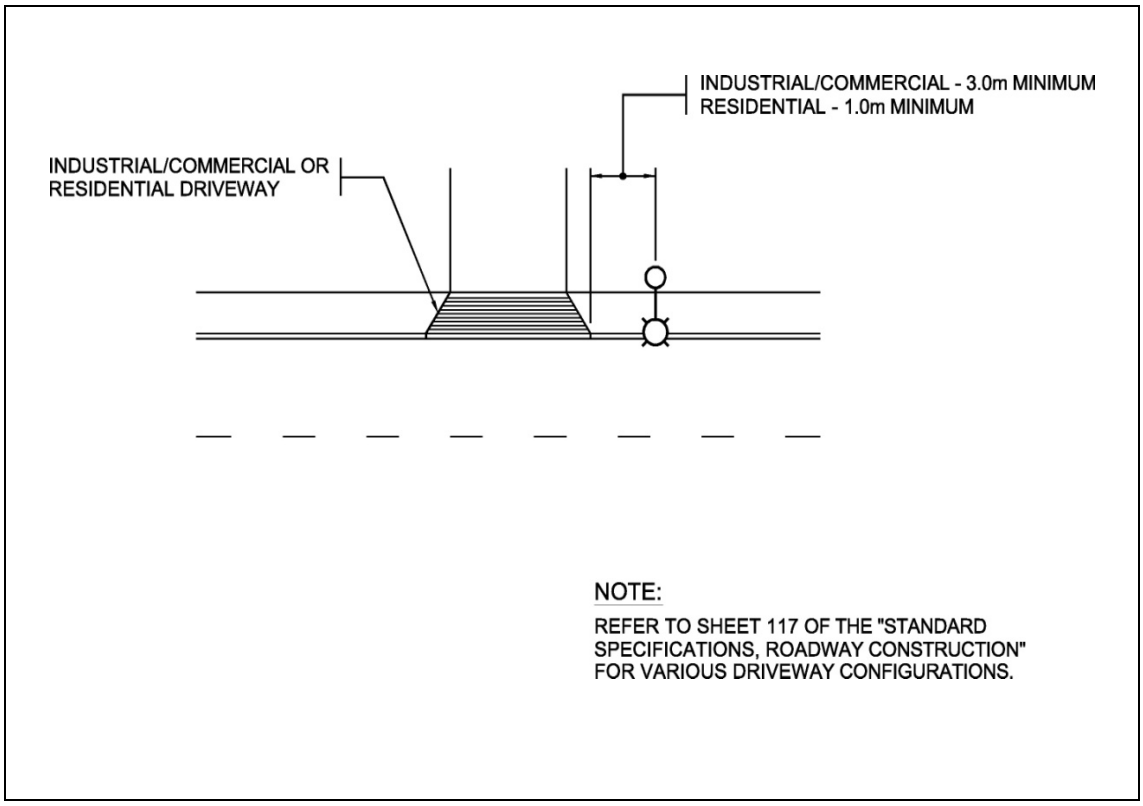


Figure 4: Location of Luminaire Poles at Driveways

7.5.3 Luminaire Poles at Fire Hydrants

Luminaire poles located beside fire hydrants shall be positioned such that the minimum clearance defined in Figure 5 below is maintained. Should physical constraints at the site not permit the required clearance to be maintained, approval of the reduced clearance to the driveway shall be obtained from the City Senior Street Lighting Engineer.

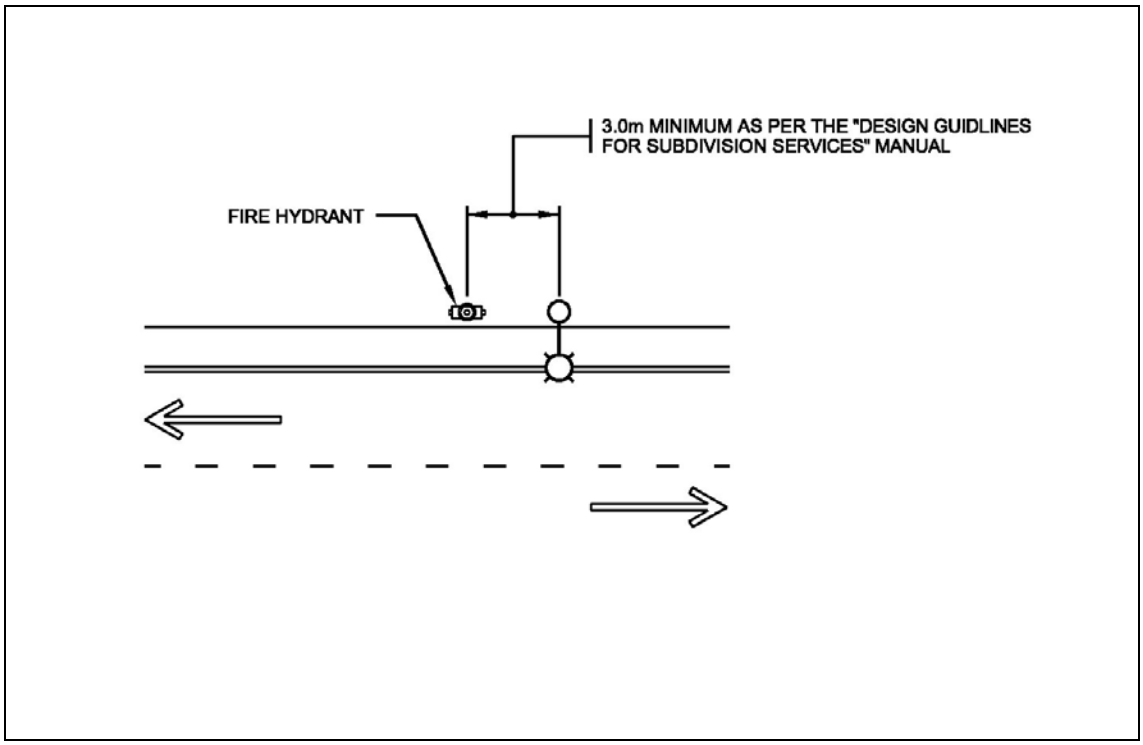


Figure 5: Location of Luminaire Poles at Fire Hydrants

7.5.4 Luminaire Poles at Trees

Luminaire poles located besides landscaping trees shall be positioned such that the minimum clearance defined in Figure 6 below is maintained. Should physical constraints at the site not permit the required clearance to be maintained, approval of the reduced clearance to the driveway shall be obtained from the City Senior Street Lighting Engineer.

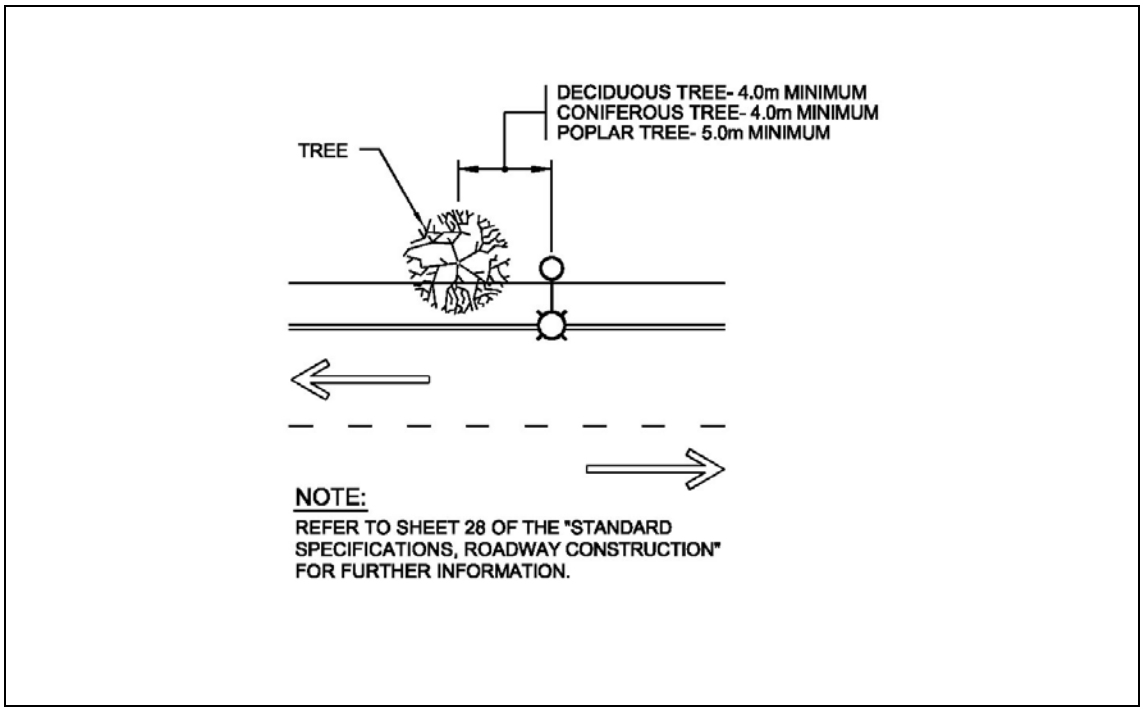


Figure 6: Location of Luminaire Poles at Trees (on City R/W)

7.6 ROADWAY LIGHTING LUMINAIRE AND POLE SETBACK

Luminaire pole setback on residential and commercial roads shall be as defined on the typical road cross-sections in Appendix A to this document. Steel pole setback requirements on freeways and expressways shall meet TAC clear zone requirements. Figure 7 below can be used to determine the minimum pole setback for steel poles without breakaway bases or where guardrail or barrier protection is not present. Concrete poles must be set back within the Low Hazard Area. Requests for reduced setback of poles in "cut" and "fill" areas must be approved by the City Senior Street Lighting Engineer. The offset is measured from the edge of pavement.

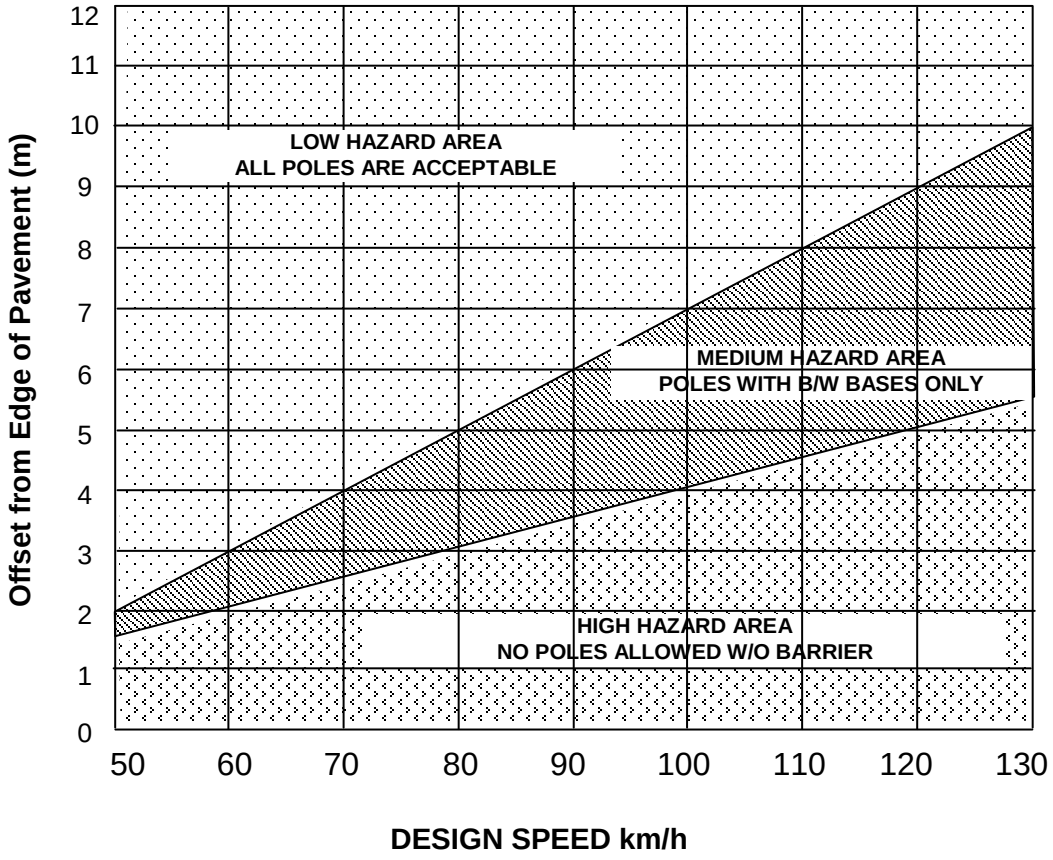


Figure 7: Luminaire Pole Setback Requirements

7.7 SPECIAL CONSIDERATIONS

Many situations arise that require special design consideration. Figure 8 below describes the minimum clearance between power lines and luminaire poles and is an example of a special consideration.

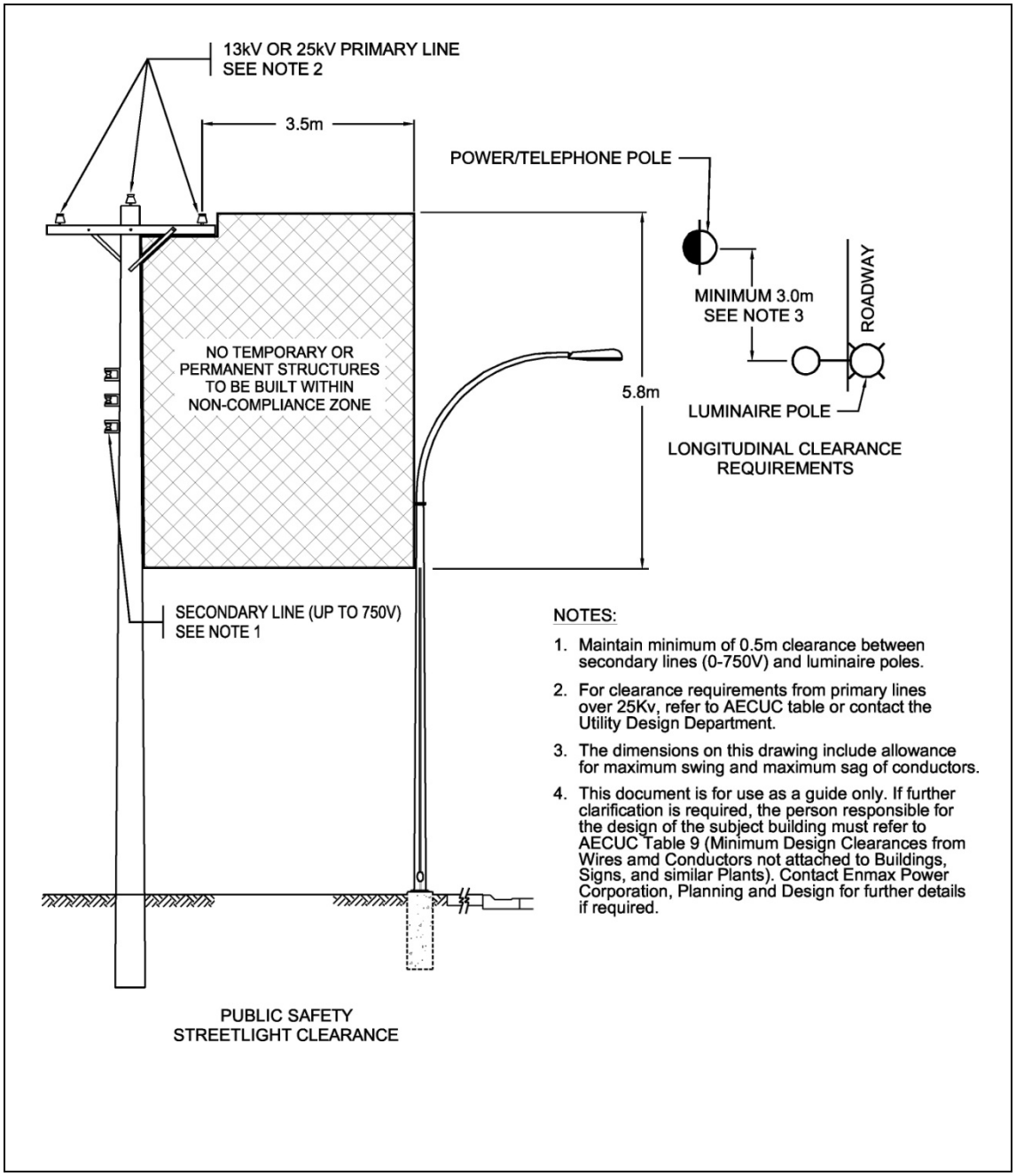


Figure 8: Minimum Horizontal and Vertical Clearances between Power Lines and Luminaire Poles

8. INTERSECTION LIGHTING

8.1 GENERAL

This section, and the terminology used, applies to intersections. In general, the City of Calgary requires lighting at all new and upgraded intersections.

8.2 INTERSECTION LIGHTING WARRANTS

For warrant purposes, intersections in the City of Calgary are divided into three classifications:

- Rural Intersections are intersections in a rural area at which two or more non-continuously lighted roadways join or cross at the same level. A rural area may be located in an agricultural, park, or greenbelt environment. It is characterized by the absence of sidewalks, parking lanes, and nearby residential or commercial development. It is usually characterized by the absence of significant pedestrian activity, particularly at night. However, this may not be the case. An example of such an instance is an intersection that is used as a transportation assembly point (such as a school bus pickup point).

  Rural Intersections require full or partial lighting as determined by the warrant process outlined in the TAC Illumination of Isolated Rural Intersections manual.

  The lighting designers shall determine, by use of the TAC warrant system and spreadsheet, which intersections in a project require lighting, and whether the lighting will be full or partial. The results shall be presented to the City Senior Street Lighting Engineer for approval before proceeding with detailed lighting design.

- Urban Intersections are intersections within an area of the city with dense commercial development such as restaurants, shopping centres, malls, movie theaters, bars, etc. Downtown central business districts are included in this category. All Urban Intersections require full lighting.

- Isolated Traffic Conflict Areas are locations separate from intersections that may present increased vehicular and pedestrian conflicts, and/or conflicts with other facilities. Such areas include mid-block crosswalks and railway grade crossings, among others. Also included are short sections of roadway with unusually complex geometry or weaving patterns, and unexpected sharp curves. Isolated Traffic Conflict Areas shall be treated as rural intersections, as outlined above.

FOR INTERSECTIONS IN THE CITY OF CALGARY, the design and installation of street lighting is required in all cases

8.3 INTERSECTION LIGHTING MATERIALS

Luminaire wattages and pole mounting heights at intersections shall match those on the approach roads if continuous lighting is required between intersections.

For isolated intersection lighting, pole heights and luminaire wattages shall be consistent with the types of intersecting roads.

If the intersection is signalized, the luminaires shall be mounted using combination signal/luminaire poles and positioned to suit the traffic signal requirements.

8.4 INTERSECTION LIGHTING DESIGN

8.4.1 Intersection Lighting

Intersections of Continuously Lighted Roads - recommended lighting design criteria for intersections in areas of continuous roadway lighting, with the exception of the intersection of Local and Local roads are outlined in Table 8: Illimunination for intersections. Recommended lighting level values are given for the Illuminance Method only. It is based on the principle that the amount of light should be proportional to the classification of the intersecting routes and equal to the sum of the values used for each separate street.

Table 8: Illuminance for Intersections

(Adopted from IES RP8-00 and modified for City of Calgary road classifications)

Roadway Lighting Classification	Average Maintained Illumination at Pavement by Pedestrian Areas Classification in Lux/fc			E_{avg}/E_{min}
	High	Medium	Low	
Major/Major	34.0/3.4	26.0/2.6	18/1.8	3.0
Major/Collector	29.0/2.9	22.0/2.2	15.0/1.5	3.0
Major/Local	26.0/2.6	20.0/2.0	13.0/1.3	3.0
Collector/Collector	24.0/2.4	18.0/1.8	12.0/1.2	4.0
Collector/Local	18.0/1.8	14.0/1.4	8.0/0.8	4.0
Local/Local	18.0/1.8	14.0/1.4	8.0/0.8	6.0

The City must grant special approval of the intersection lighting design.

URD RESIDENTIAL SUBDIVISIONS: All intersection lighting calculations for URD residential subdivisions shall be done using illuminance methods.

8.4.2 Isolated Intersections and Isolated Traffic Conflict Areas

- Illuminance Method - Recommended lighting design criteria for isolated intersections and isolated traffic conflict areas using the Illuminance Method are detailed in IES RP-8 Table 9.

8.5 INTERSECTION LIGHTING LAYOUT

Typical suggested intersection lighting luminaire pole layouts are shown in Figures 9 to 19 for various intersection configurations. Pole heights and luminaire wattages shall be determined by the lighting designers to suit the size of the intersection and the lighting design criteria.

In the intersection areas, as defined in Figures 9 to 19, the lighting levels should meet the illuminance level described in Table 8: Illuminance for intersections. In cases where this not possible, a minimum of 150% of the highest design average lighting level for the intersecting roads should be achieved.

Consideration shall be given to the possible future signalization of intersections with the interim luminaire poles located accordingly. The intent is to ensure that the lighting designers take into account the possibility of future installation of roadway luminaires on traffic poles, and to design accordingly, thus minimizing pole relocation/ removal when traffic signals are added to the intersection. Proper illumination of the intersection is required until traffic signals are installed. This may be done on temporary wooden poles.

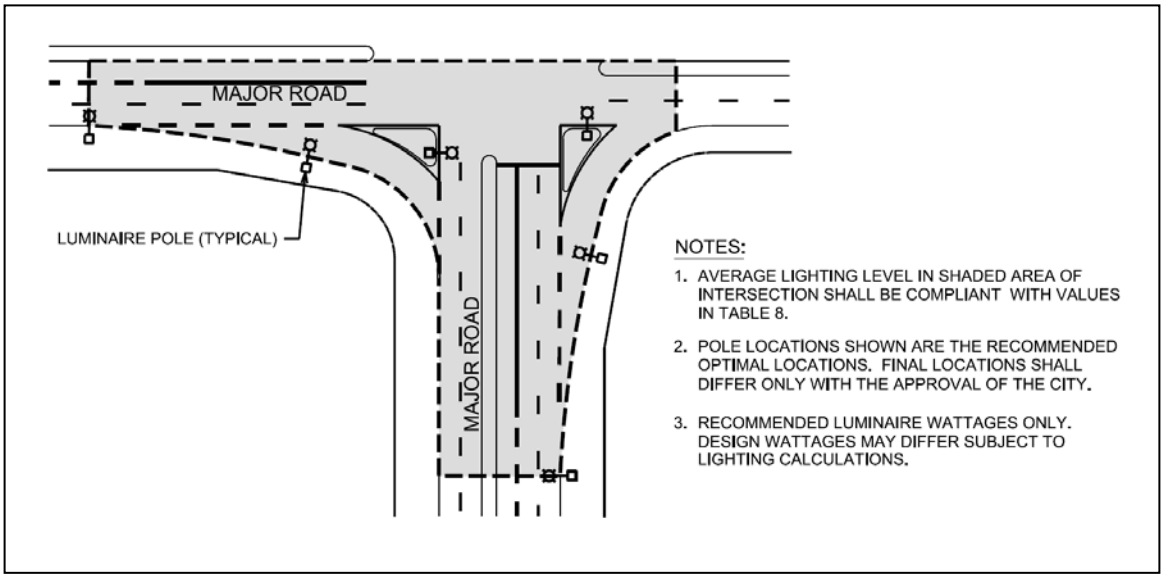


Figure 9: Typical Intersection of Major Road and Major Road

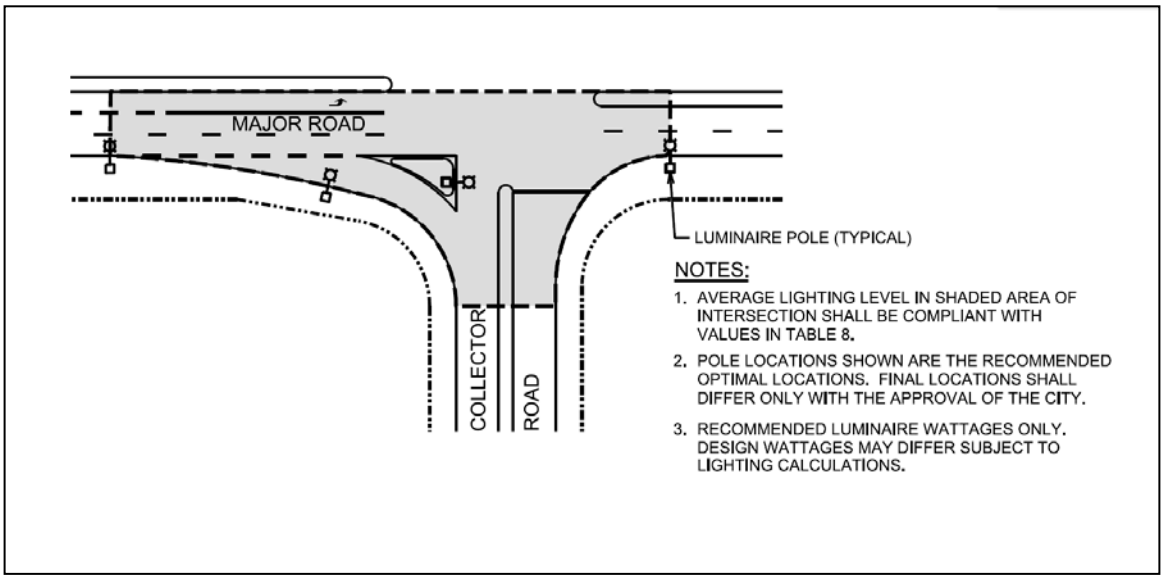


Figure 10: Typical Intersection of Major Road and Collector Road

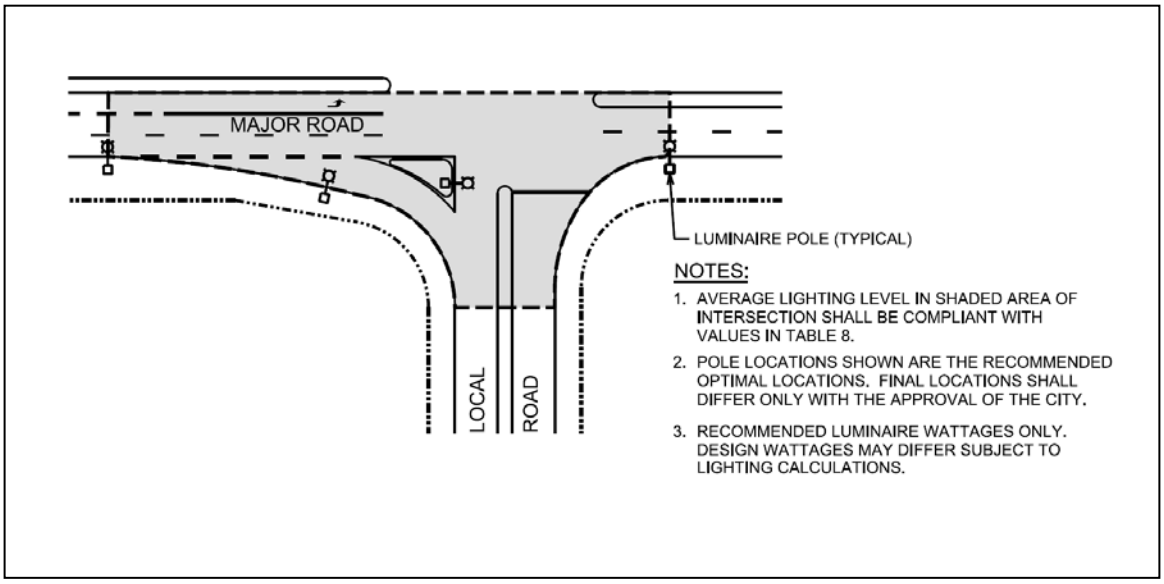


Figure 11: Typical Intersection of Major Road and Local Road

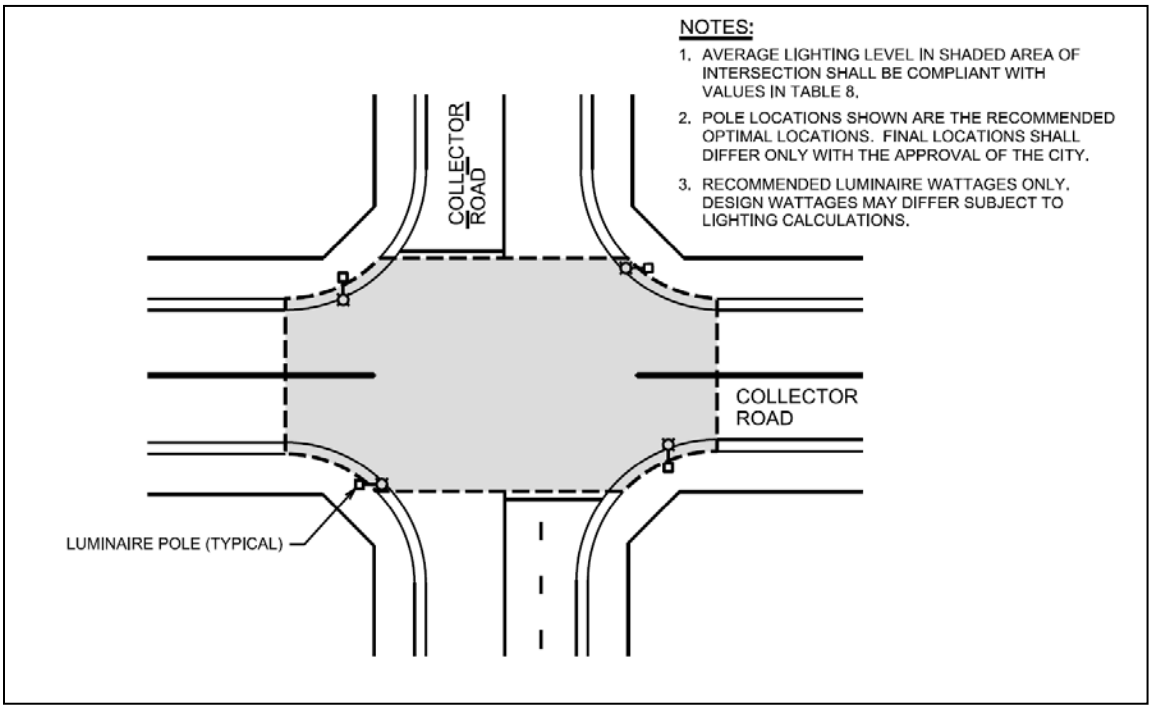


Figure 12: Typical Intersection of Collector Road and Collector Road

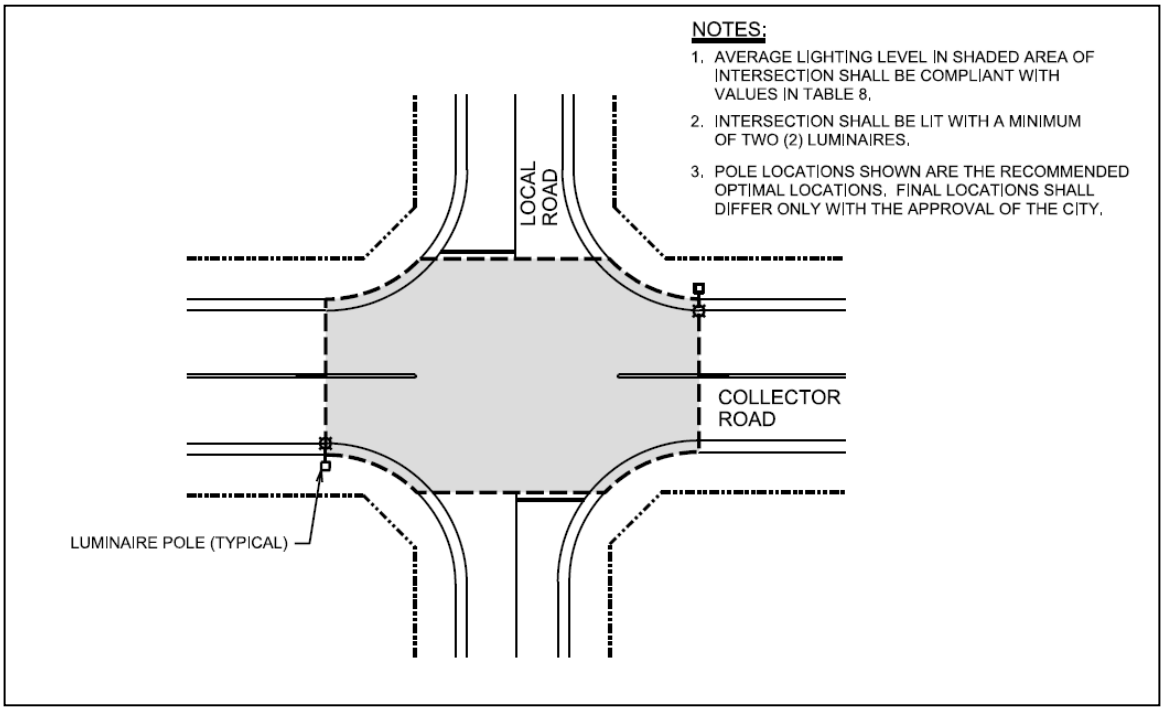


Figure 13: Typical Intersection of Collector Road and Local Road

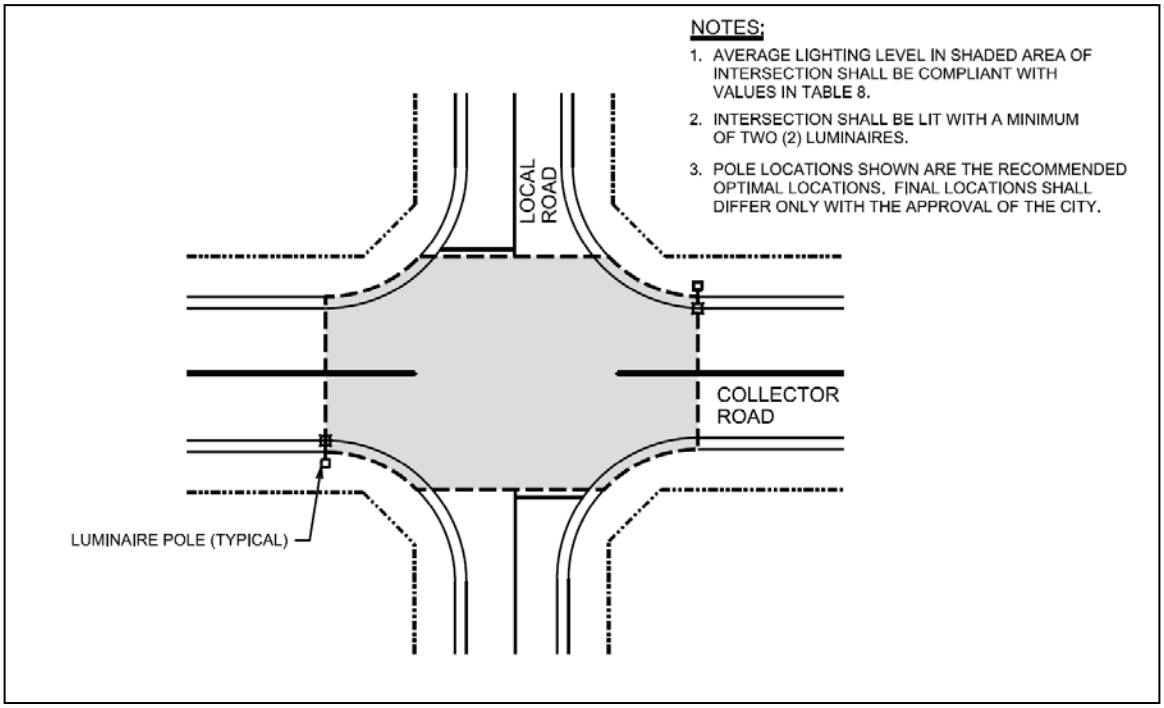


Figure 14: Typical 'T' Intersection of Collector Road and Local Road

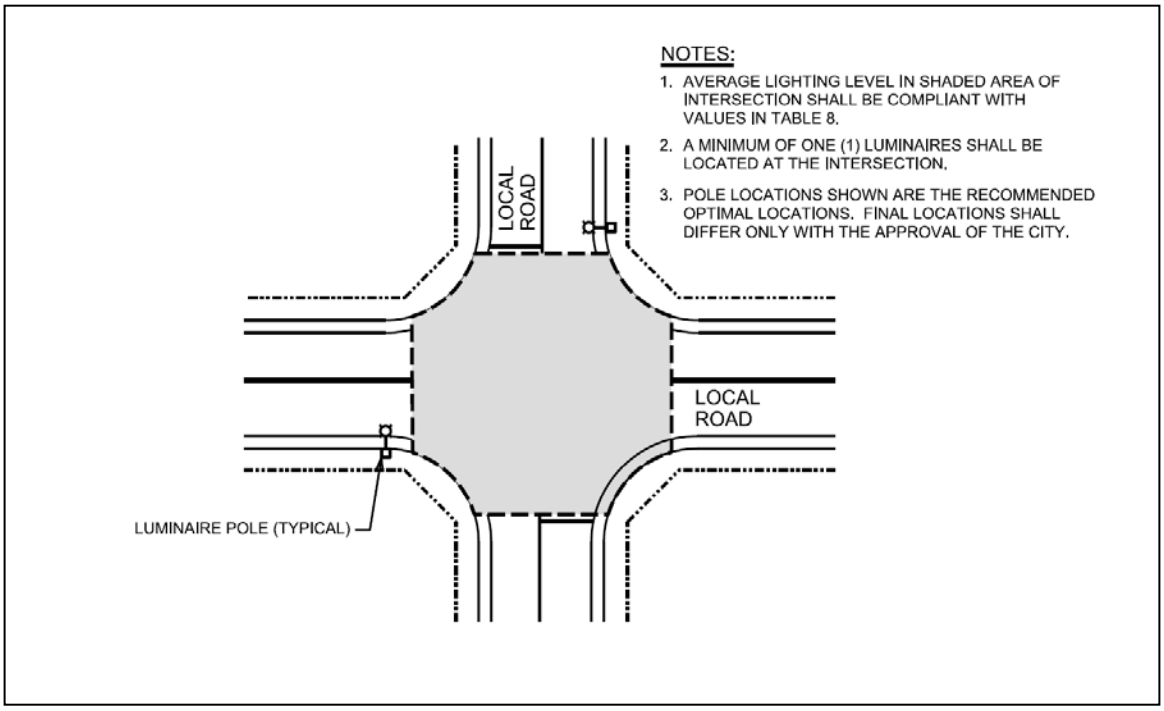


Figure 15: Typical Intersection of Local Road and Local Road

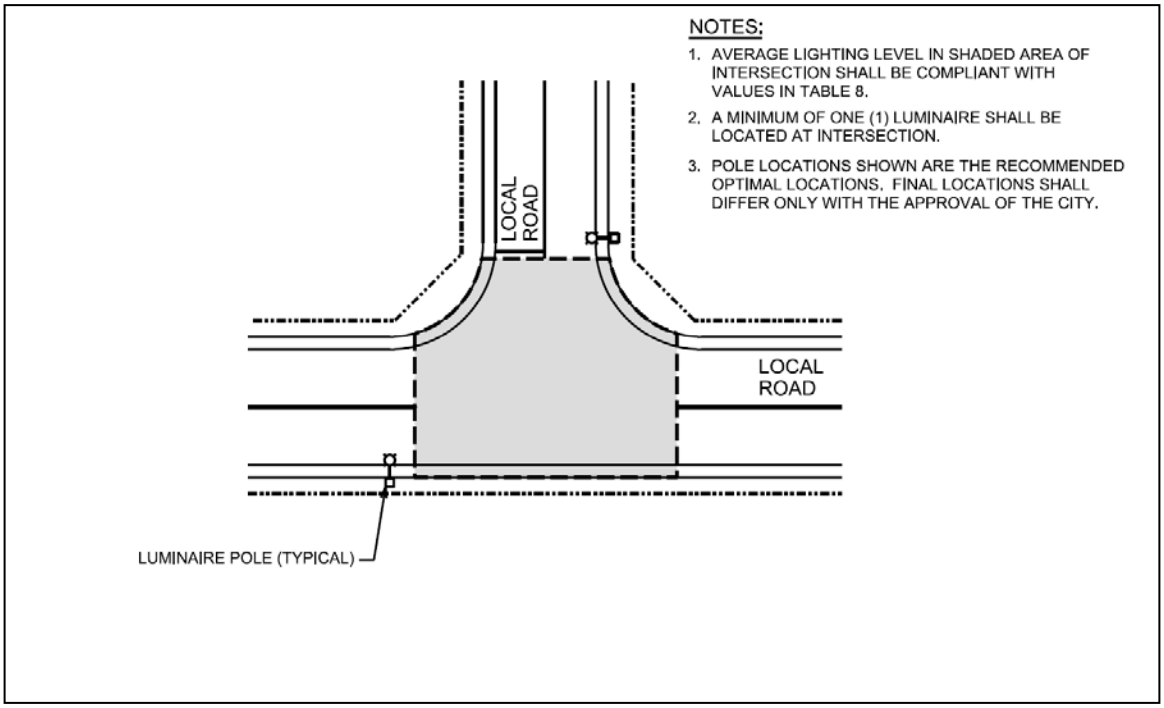


Figure 16: Typical 'T' Intersection of Local Road and Local Road

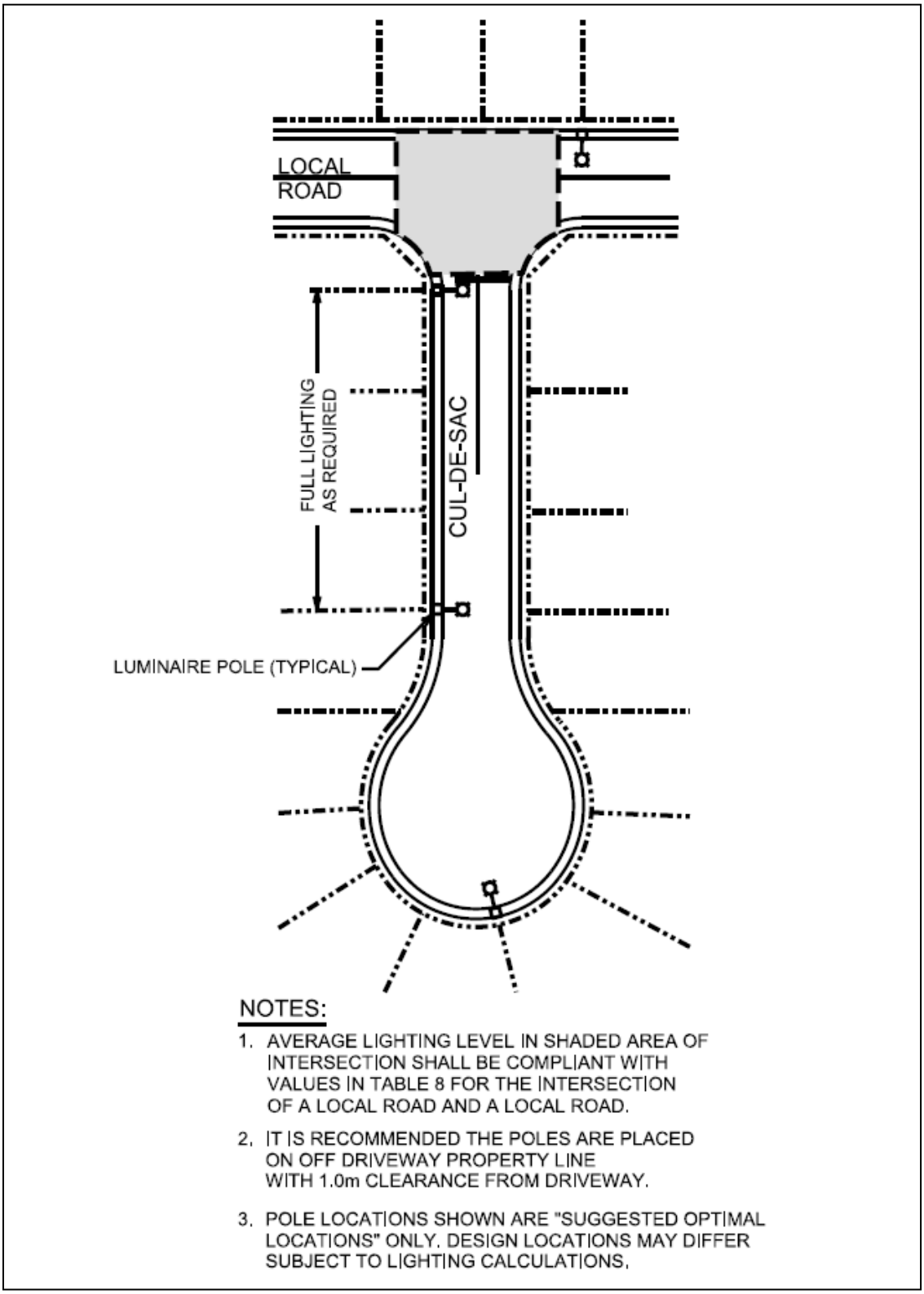


Figure 17: Typical Cul-de-sac on a Local Road

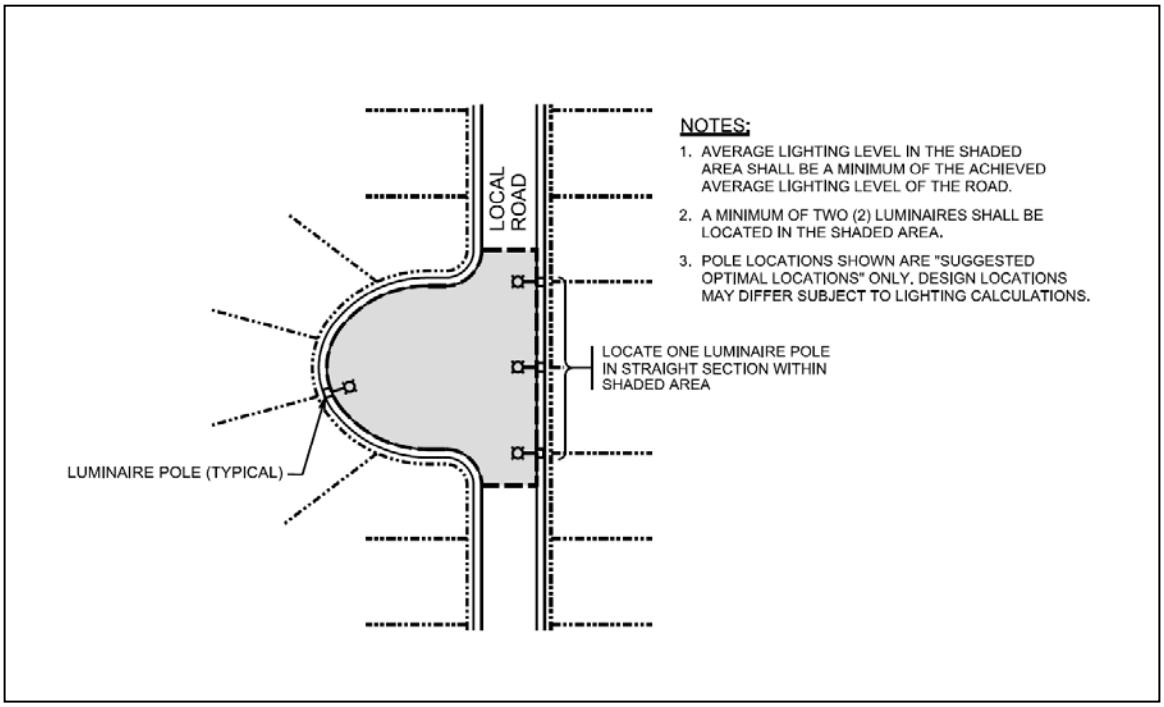


Figure 18: Typical Bulb on a Local Road

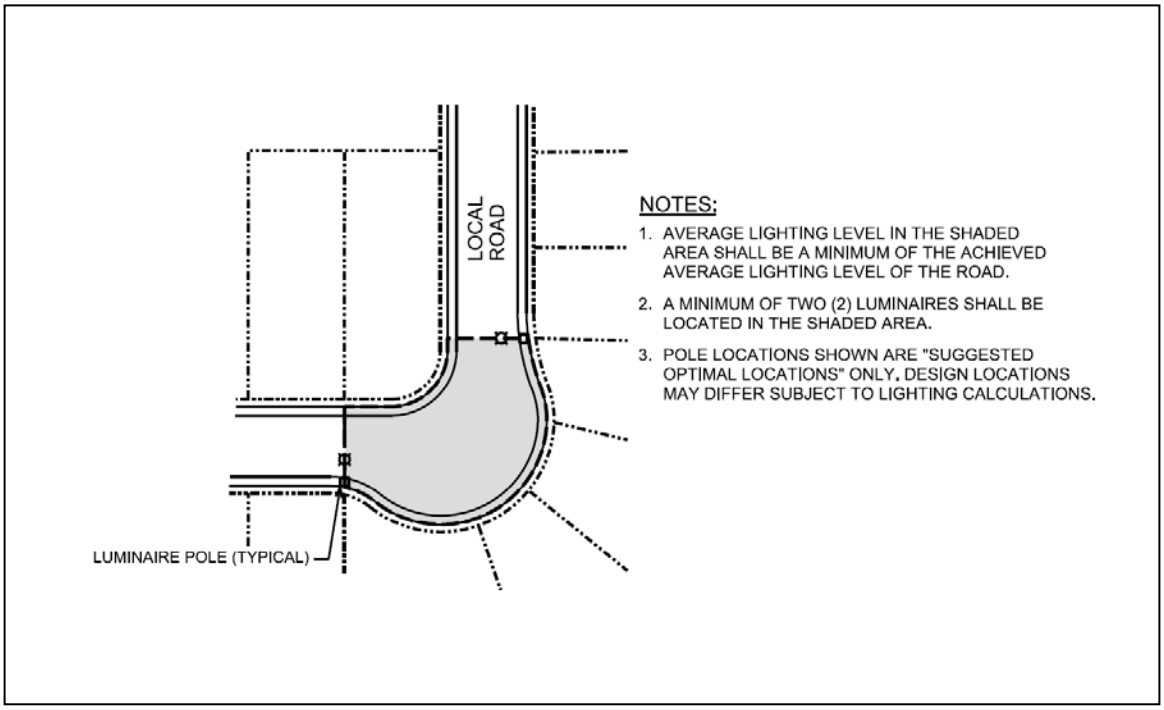


Figure 19: Typical Corner Bulb on a Local Road

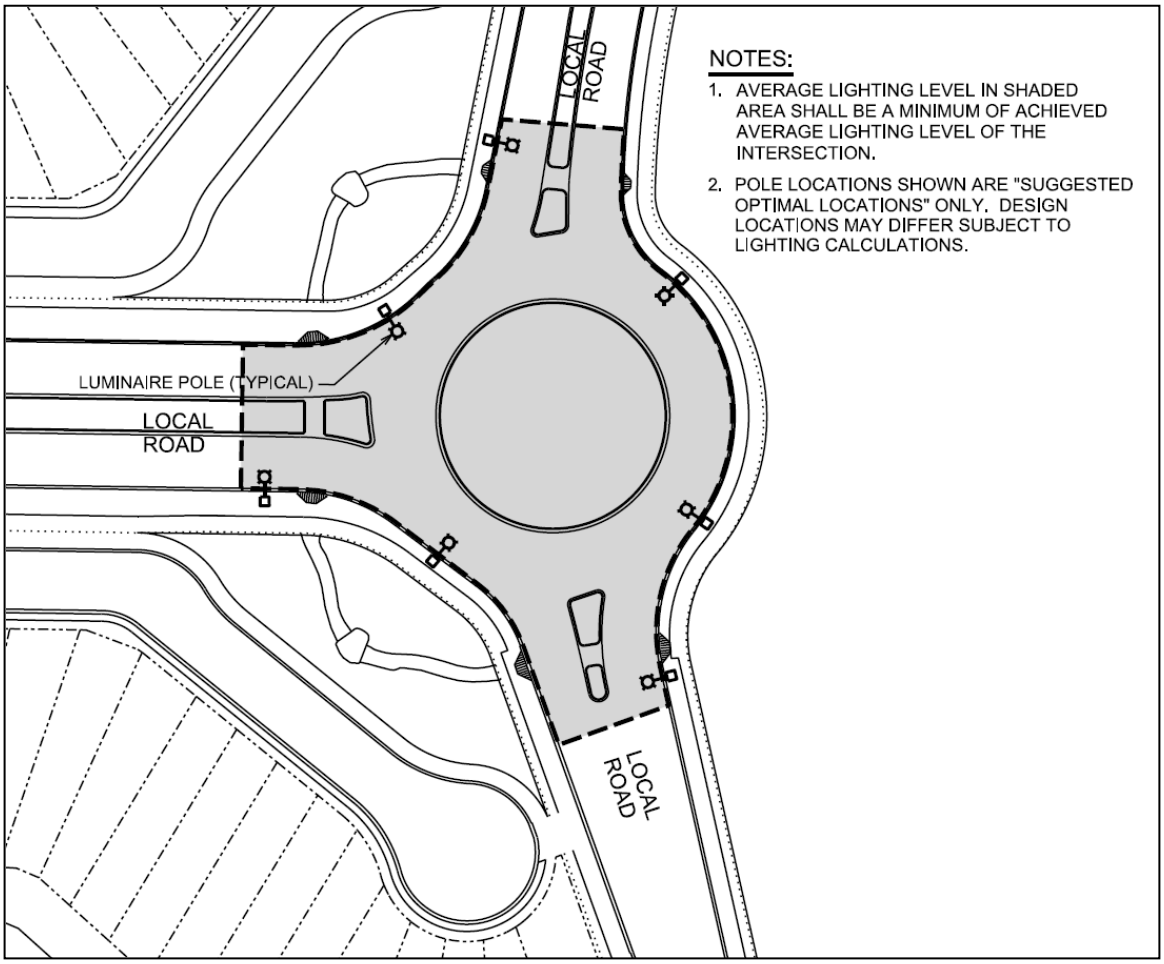


Figure 20: Typical Traffic Circle Intersection

9. INTERCHANGE LIGHTING

9.1 GENERAL

Interchanges are controlled access intersections generally utilizing on and off ramps and underpasses and overpasses in a separated grade configuration. Interchanges are usually restricted to roadways that are classified as freeways or expressways. However, interchanges can occasionally occur on arterial roads.

9.2 INTERCHANGE LIGHTING WARRANTS

For warrant purposes, interchanges are divided into two classifications:

- Urban Area – an interchange that exists within an urban area requires full lighting
- Suburban or Urban Area – an interchange that exists within a suburban or urban area requires, as a minimum, partial lighting

Full lighting, or expanded partial lighting, may be required at Suburban or Urban Interchanges if accident rates are repeatedly above the critical rates as determined by a roadway safety audit.

Full lighting, or expanded partial lighting, may be required at Suburban or Urban Interchanges along sections with high traffic weaving volumes, or with unusually complex traffic patterns.

FOR INTERCHANGES IN THE CITY OF CALGARY, the design and installation of street lighting is required in all cases

9.3 INTERCHANGE LIGHTING MATERIALS

Luminaire and pole types, though not necessarily mounting heights and wattages, shall match those on the roadways associated with the interchange. Pole heights and luminaire wattages shall be determined through lighting design optimization.

The exception shall be where the use of high mast lighting has been approved by the City Senior Street Lighting Engineer.

9.4 INTERCHANGE LIGHTING DESIGN

Interchanges that require full lighting, as determined by the warrants outlined above, are subject to the design criteria outlined in Section 7 - Roadway Lighting.

Interchanges that require partial lighting, as determined by the warrants outlined above, are subject to the design criteria outlined in Section 8.4.2 - Isolated Intersections and Isolated Traffic Conflict Areas.

Interchanges are generally made up of on/off ramps, acceleration and deceleration lanes, the main roadway (typically a freeway or expressway), and a crossroad (usually a major or collector road). Interchanges can come in different shapes and configurations, from diamond interchanges to full cloverleaf interchanges. Connections between two freeways or expressways are often served by large high-speed complex interchanges with multiple levels, ramps, overpasses, and flyovers.

9.5 INTERCHANGE LIGHTING LAYOUT

Interchange lighting design and luminaire pole layout, as required by the warrants, shall adhere to the following principles:

- The main roadway shall be designed as required for typical roadways
- The intersections of the ramps and the crossroads shall be designed as required for intersections
- The ramps, acceleration and deceleration lanes, where full lighting is required, shall be designed as required for typical roadways
- The ramps, acceleration and deceleration lanes, where partial lighting is required, shall be designed as per Figures 21, 22 and 23 below

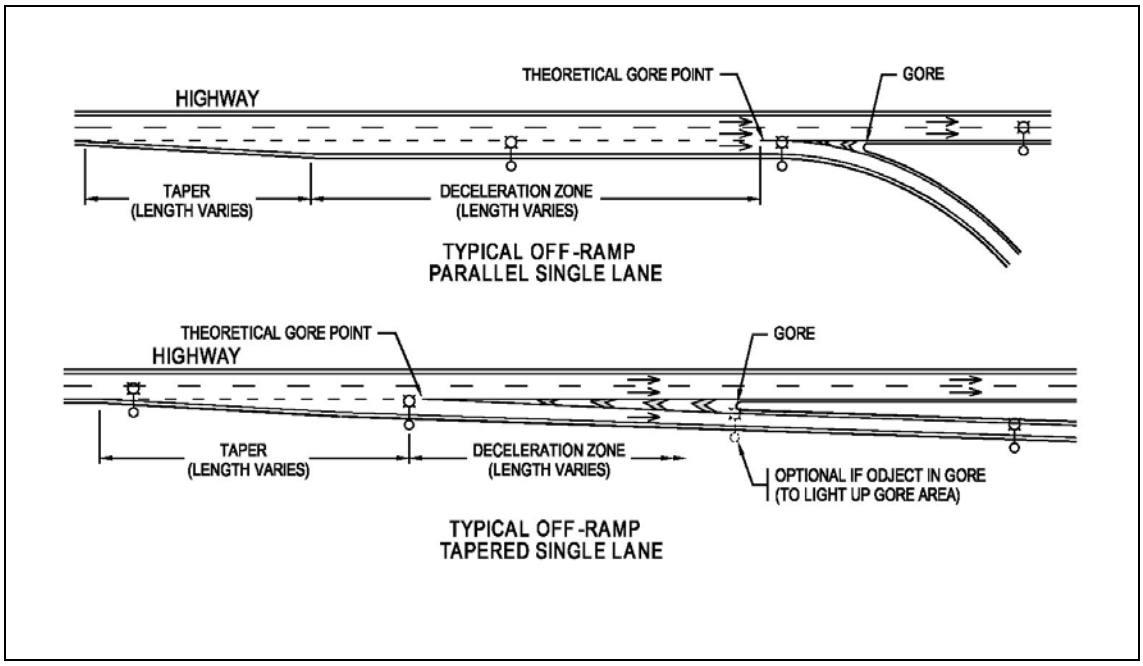


Figure 21: Typical Off-Ramp - Partial Lighting

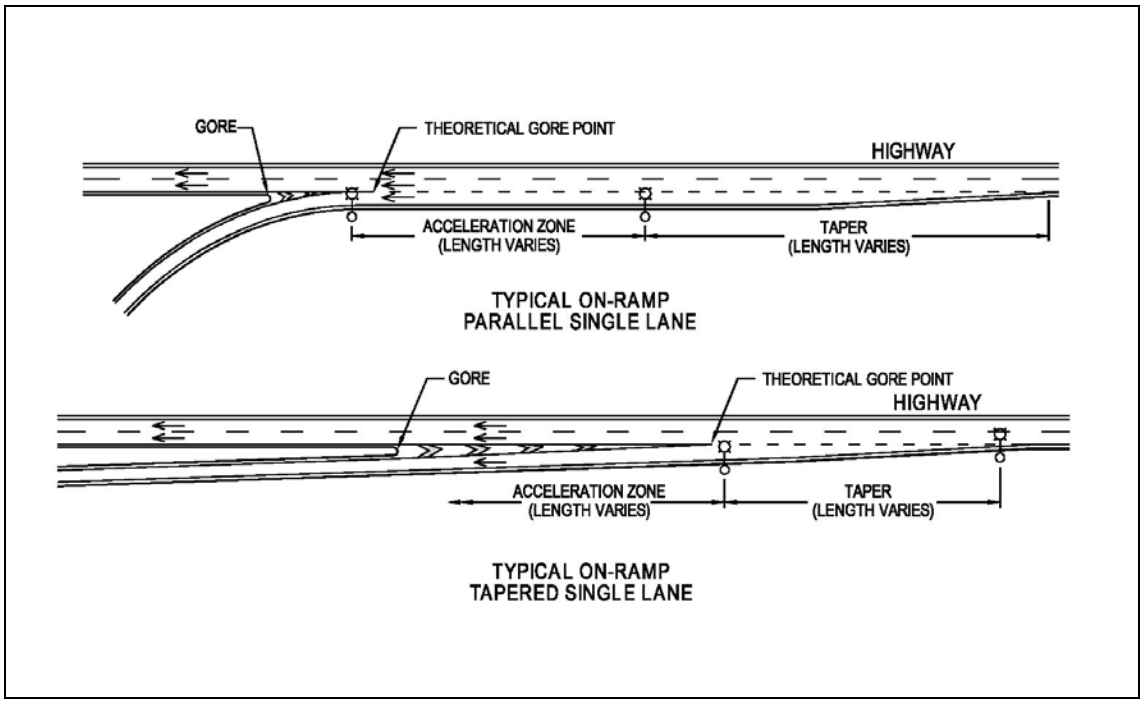
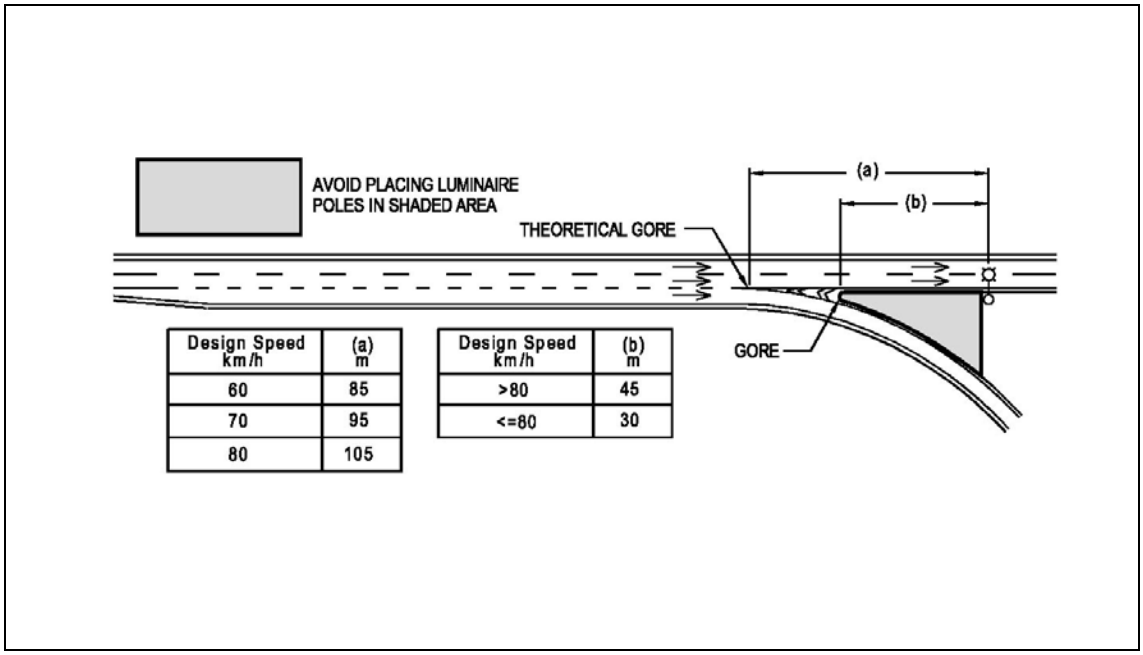


Figure 22: Typical On-Ramp - Partial Lighting



Design Speed km/h	(a) m
60	85
70	95
80	105

Design Speed km/h	(b) m
>80	45
<=80	30

Figure 23: Typical Pole Location in Gore Area

10. PEDESTRIAN AND BICYCLE TUNNEL LIGHTING

10.1 GENERAL

The purpose of pedestrian and bicycle tunnel lighting is to provide for night time and, where necessary due to the length or geometric configuration of the tunnel, day time vision.

10.2 PEDESTRIAN AND BICYCLE TUNNEL LIGHTING WARRANTS

Lighting is always required in pedestrian and bicycle tunnels in the City of Calgary.

10.3 PEDESTRIAN AND BICYCLE TUNNEL LIGHTING MATERIALS

Pedestrian and bicycle tunnels are generally illuminated with City pre-approved LED Wallpack as listed in the City's Pre-approved Electrical Materials and Equipment List. IES format photometrics for the luminaires are available from the luminaire manufacturers. Other light sources may also be used upon special approval of the City Senior Street Lighting Engineer.

10.4 PEDESTRIAN AND BICYCLE TUNNEL LIGHTING DESIGN

Recommended lighting design criteria for pedestrian tunnels and bicycle tunnels are detailed in IES RP-8 Table 7.

Alternate recommended lighting design criteria for pedestrian tunnels and bicycle tunnels are detailed in IES DG-5 Table 2 and Table A-1.

10.4.1 Pedestrian vs. Bicycle Designation

The recommended lighting levels for bicycle tunnels are higher than for pedestrian tunnels. Therefore, the lighting designers shall determine if the designated usage of the tunnel, as determined by The City and/or the Civil Designers, corresponds with the designated usage for lighting purposes.

For example, a tunnel may be designated as a bicycle tunnel by the project. However, barrier railings are placed at the entrances of the tunnel forcing the rider to dismount and walk the bicycle through the tunnel. For lighting purposes, this tunnel is designated as a pedestrian tunnel with its corresponding lower lighting level, not as a bicycle tunnel. For lighting purposes, tunnels shall only be designated as bicycle tunnels if the riders can travel through the tunnel by riding.

10.5 PEDESTRIAN AND BICYCLE TUNNEL LIGHTING LAYOUT

For pedestrian or bicycle tunnels that are a standard walkway width (with a walkway approximately 3 m wide), a 3.0 m luminaire spacing for bicycle tunnels

and a 4.5 m luminaire spacing for pedestrian tunnels will generally provide acceptable lighting levels on the walkway surface.

Pedestrian and bicycle tunnels that are wider than standard pathways will require lighting design calculations to determine the required luminaire spacing to meet the required design criteria.

Pedestrian and bicycle tunnel luminaires are generally illuminated to full design lighting levels during the day and 50% day time lighting levels at night. Luminaires shall be controlled at night using the City standard photocell and a normally closed relay located in the service panel. In special cases of increased security, The City may require that the lighting remain at full levels both day and night. Lighting designers shall inquire about this requirement with the City Senior Street Lighting Engineer.

Pedestrian and bicycle tunnels require lighting at the entrances and exits of the structures. Refer to Section 10.4 – Pedestrian Walkway and Bikeway Lighting for details on walkway lighting design. For tunnels that are in areas of non-continuous lighting, one post-top walkway light will be required at a strategic location near the each end of the tunnel. For tunnels that are in the vicinity of roadway lighting, adequate lighting at the tunnel entrances may be possible with strategic placement of the roadway luminaires.

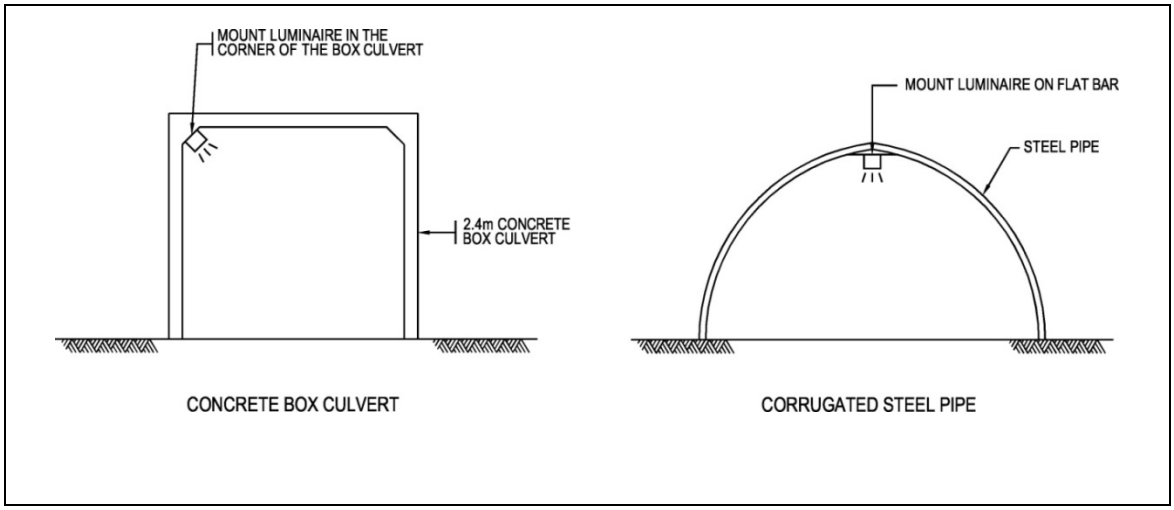


Figure 24: Typical Pedestrian and Bicycle Tunnel Lighting

11. VEHICLE TUNNEL LIGHTING

11.1 GENERAL

The purpose of general roadway lighting in tunnels is to provide for night time vision. However, the primary purpose of tunnel lighting is to provide proper internal pavement and wall luminance to counteract the effects of entering a dark restricted area during the day time.

Vehicle tunnels are structures in which the length, in the direction of travel, is longer than the width of the structure. Any structure where the width is greater than the length is considered an underpass.

All vehicle tunnel projects are considered to be special projects and, as such, require project specific research to determine the best solution for the lighting design. Prior to designing a tunnel lighting system, lighting designers shall thoroughly review the project with the City Senior Street Lighting Engineer.

11.2 VEHICLE TUNNEL LIGHTING WARRANTS

For Vehicle tunnels, as specified by IES RP-22 – American National Standard Practice for Tunnel Lighting. It shall be noted that the lighting requirements methodology of RP-22 may indicate that no lighting is required for certain tunnels, particularly short tunnels with good wall reflectance or good daylight penetration. It should also be noted that a tunnel that does not warrant day time lighting might require night time lighting if the adjacent roadway is warranted for lighting.

11.3 VEHICLE TUNNEL LIGHTING MATERIALS

The City has no standard lighting materials or methods for lighting vehicle tunnels. Selection of luminaire type, mounting location, wattage and distribution forms a major part of the tunnel lighting design process and should be reviewed with the City Senior Street Lighting Engineer.

For minor tunnel projects, luminaire types shall be restricted to High Pressure Sodium, Metal Halide, or LED.

For major tunnel projects, particularly tunnels long enough to have an “interior zone”, all light sources should be considered, including linear fluorescent systems.

All luminaires used in tunnel projects shall be specifically designed and developed for tunnel applications. The use of general application lighting fixtures or industrial luminaires should be avoided.

Luminaire selection shall consider, among others, the following:

- Luminaire efficiency
- Durability and constructability
- Maintainability

11.4 VEHICLE TUNNEL LIGHTING DESIGN

Tunnel lighting systems shall meet the lighting design criteria and requirements of, and calculations shall be undertaken by using the methods outlined in IES RP-22 American National Standard Practice for Tunnel Lighting. The lighting design criteria and design methods vary depending on the size, length, and geographical location of the tunnel. The lighting designers shall determine the lighting design criteria and select the most appropriate method for lighting the tunnel. In particular, consideration should be given to the following items:

- For major tunnels the threshold luminance values, L_{th}, should be determined for each tunnel portal using the L_{SEQ} (Equivalent Veiling Luminance) Method as outlined in IES RP-22, Annex B
- For minor tunnels the threshold luminance values, L_{th}, may determine by using the standard tables included in IES RP-22 Section 6 Lighting Design Criteria, including the table of adjustment factors, however, the L_{SEQ} Method may also be used to provide more site specific results

Wall luminance criteria are to be considered as important as the pavement luminance.

Veiling luminance (glare) criteria must be met for all tunnel lighting designs.

All lighting design applications shall be considered, including symmetrical and linear lighting systems, and asymmetrical pro-beam or counter-beam lighting systems.

Lighting system economic analysis shall be considered in all designs and a 25 year life cycle cost analysis shall be undertaken for all proposed and competing design methods as outlined in IES RP-22 Section 9 Lighting System Economics.

For new tunnel projects, tunnel lighting design principles shall be presented and discussed with the structural and architectural designers of the tunnel. Architectural features of tunnel approaches and portals, and highly reflective tunnel wall and ceiling materials, can greatly affect the amount of lighting required in a tunnel, and therefore the capital cost and ongoing operational cost. Recommendations for these considerations are outlined in IES RP-22.

Energy efficiency is a key-determining factor in a tunnel lighting design given the large quantity of luminaries required for a tunnel project. In order to achieve the best energy efficiency, multi-level lighting controls will be required for all tunnel projects. Illuminance levels should be at the highest level in bright sunlight and at the lowest level in darkness. Typically, major tunnels should have at least three day time lighting levels and a separate night time lighting level.

Lighting is required for the external approach zone and exit zone of all tunnels that warrant night time lighting. The lighting design criteria for these areas are outlined in IES RP-22.

Research and development of new tunnel lighting design criteria and design methods are continuously ongoing by the IES as well as other lighting engineering research groups from Europe, such as the International Commission on Illumination (Commission Internationale de L'eclairage - CIE). All new design methods and criteria, even if not officially adopted by the IES, will be considered for tunnel projects, providing it can be shown that proper engineering principles are maintained and that safety is not compromised.

The selected tunnel lighting design criteria and design method must be approved by the City Senior Street Lighting Engineer prior to proceeding with the detailed design.

12. UNDERPASS AND OVERPASS LIGHTING

12.1 GENERAL

When a highway passes under a crossroad it is called an underpass; when a highway passes over a crossroad it is called an overpass. Underpasses are usually less than 20 m long in direction of the highway travel, while overpasses may be 30 m or longer, in the direction of the crossroad travel. Underpasses and overpasses are structures in which the length, in the direction of travel, is shorter than the width of the structure. Any structure where the length is greater than the width is considered a tunnel.

This section, and the terminology used, only applies to underpasses (the roadways below the structure). Overpasses (roads that are the along the top of the structures) are covered as part of general roadway or bridge lighting.

12.2 UNDERPASS AND OVERPASS LIGHTING WARRANTS

Lighting is generally required for underpasses where there is adjacent roadway, intersection, or interchange lighting and where one or more of the following conditions exists:

- The structures run for more than 20 m over top of the roadway
- Where sidewalks and bicycles lanes are present under the structure

Where lighting is required, the lighting design criteria must meet those required on the entrance roadways. Day time lighting is never required for underpasses.

Underpasses are generally illuminated with 60W – 90W LED City pre-approved wall mount luminaire.

12.3 UNDERPASS AND OVERPAS LIGHTING DESIGN

Where possible, lighting inside underpasses and overpasses shall be provided by the strategic placement of roadway luminaire poles on either side of the structure. Sufficient lighting may be provided by the overlap of the luminaire beam spread providing that shadowing does not occur from either the poles being too high, or the structure being too low.

Roadway luminaire poles along the road beneath the structure should be located a minimum of one pole height away from the structure for good lighting distribution under the structure and to limit the obtrusive glare on the roadway along the top of the structure.

If the adjacent roadway luminaire poles cannot provide proper lighting then wall mount luminaires may be required as shown on Figure 25.

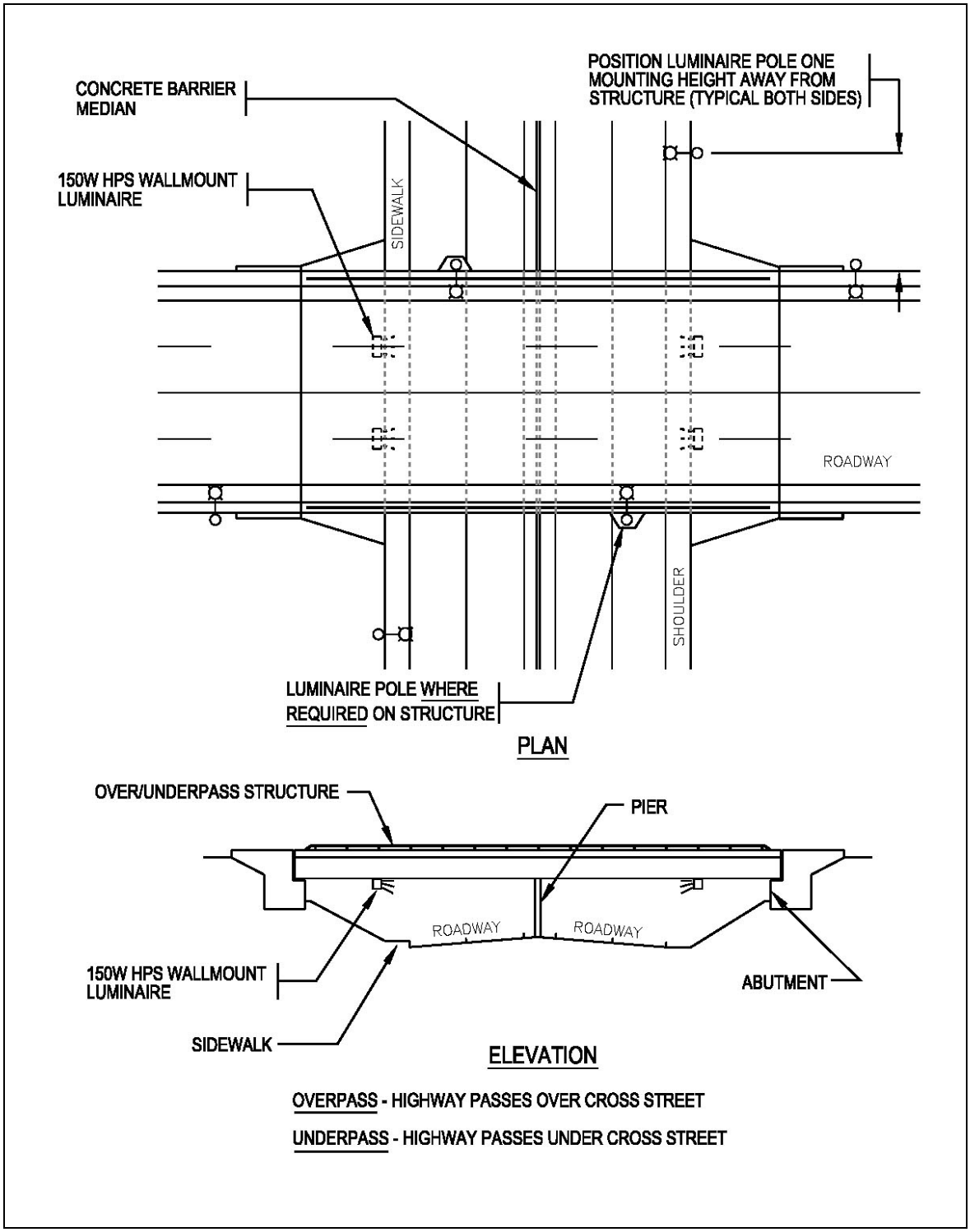


Figure 25: Typical Underpass Lighting

13. BRIDGE LIGHTING

13.1 GENERAL

All major bridge projects are considered to be special projects and, as such, have project specific requirements particular to bridges. Major bridge projects will require project specific research to determine the best solution for the lighting design. Prior to designing a major bridge lighting system, lighting designers shall thoroughly review the project with the City Senior Street Lighting Engineer.

Minor bridge projects, including the roadways along the tops of under/overpasses, are generally treated the same as the roadway that they form part of. As such, they do not require special consideration for lighting.

13.2 BRIDGE LIGHTING WARRANTS

Roadway lighting on bridges is not required unless warranted as part of the regular roadway lighting.

If the bridge does not meet the general roadway lighting warrants then roadway lighting may be considered, at the discretion of the City Senior Street Lighting Engineer, on bridges and their approach ramps where one or more of the following situations exists:

- Sag or crest vertical curves exist where the roadway cannot be illuminated by vehicle headlights for at least one Safe Stopping Site Distance (SSSD)
- Shoulder widths are less than 2.5m
- Bridges are 500m or longer
- Sidewalks are present and pedestrians regularly use the bridge. If the bridge has a medium to high pedestrian usage, and the sidewalks are separated from the traveled roadway by a physical barrier, then walkway lighting should be considered instead of continuous roadway lighting, unless roadway lighting is warranted

13.3 BRIDGE LIGHTING MATERIALS

For most projects, all materials used for bridge lighting shall be provided in The City Approved Street Lighting Luminaires List. For copy, contact The City Street Light Design Team.

In all cases the lighting designers shall ensure pole hand holes are easily accessible. Special modified pole designs may be required with hand holes located to allow ease of maintenance.

Luminaires on bridges shall be specified with anti-vibration devices, which are supplied as an option by the City pre-approved cobra head luminaire suppliers.

When non standard materials are requested, they must be approved by the City Senior Street Lighting Engineer. The following specifications are a minimum for Street Light Fixtures:

- Must have CSA Label as proof of approval
- Must have IP66 Certification
- Must have 3G vibration Certification
- Must be temperature rated from -40°C to +40°C
- Must have IES files
- Must be applicable for outdoor, damp, and dry locations

13.4 BRIDGE LIGHTING DESIGN

No special design criteria are provided specifically for bridges. Bridge lighting shall meet the recommended lighting design criteria for the roadway classification that the bridge falls into. Refer to Section 7 – Roadway Lighting for roadway lighting design criteria.

If lighting is not warranted along a bridge, but it is expected or conceivable that lighting may be required in the future due to future road improvements or future reclassification of the roadway or land use, it is recommended that the installation of conduit and pole bases on the bridge structure be considered to accommodate the installation of lighting in the future. Lighting designers shall discuss the requirement for installing pole bases and conduit on the bridge with the City Senior Street lighting Engineer.

13.5 BRIDGE LIGHTING LAYOUT

When roadway lighting is required on a bridge, lighting designers shall:

- Locate the luminaire poles off the side of the bridge structure, parapet, or deck
- Orient pole hand holes to allow ease of maintenance from the bridge deck
- Where feasible, avoid the use of junction boxes in bridges by making wiring connections in the pole hand holes

Typical luminaire pole mounting details on bridge structures are shown in Figure 25.

13.6 BRIDGE PIER LIGHTING

The preferred method of indicating the hazard of a bridge pier is by floodlighting. However, floodlighting may not be practical for some bridge structures or for small bridges. If floodlighting is not practical, hazard marker lighting may be required at the base of the pier.

Floodlight type and lighting levels shall meet the approval of the City Senior Street Lighting Engineer.

Where possible and for ease of maintenance, the lighting designers shall install the floodlights on a special swing hanger and locate them near the deck level.

Hazard marker lights shall be located near the base of the pier to provide proper warning of the structure.

Floodlights or hazard markers shall be controlled by a photocell for night time only operation.

Floodlights shall be shielded to reduce light trespass or glare onto adjacent areas, including the reduction of disability glare in the direction of traveling watercraft.

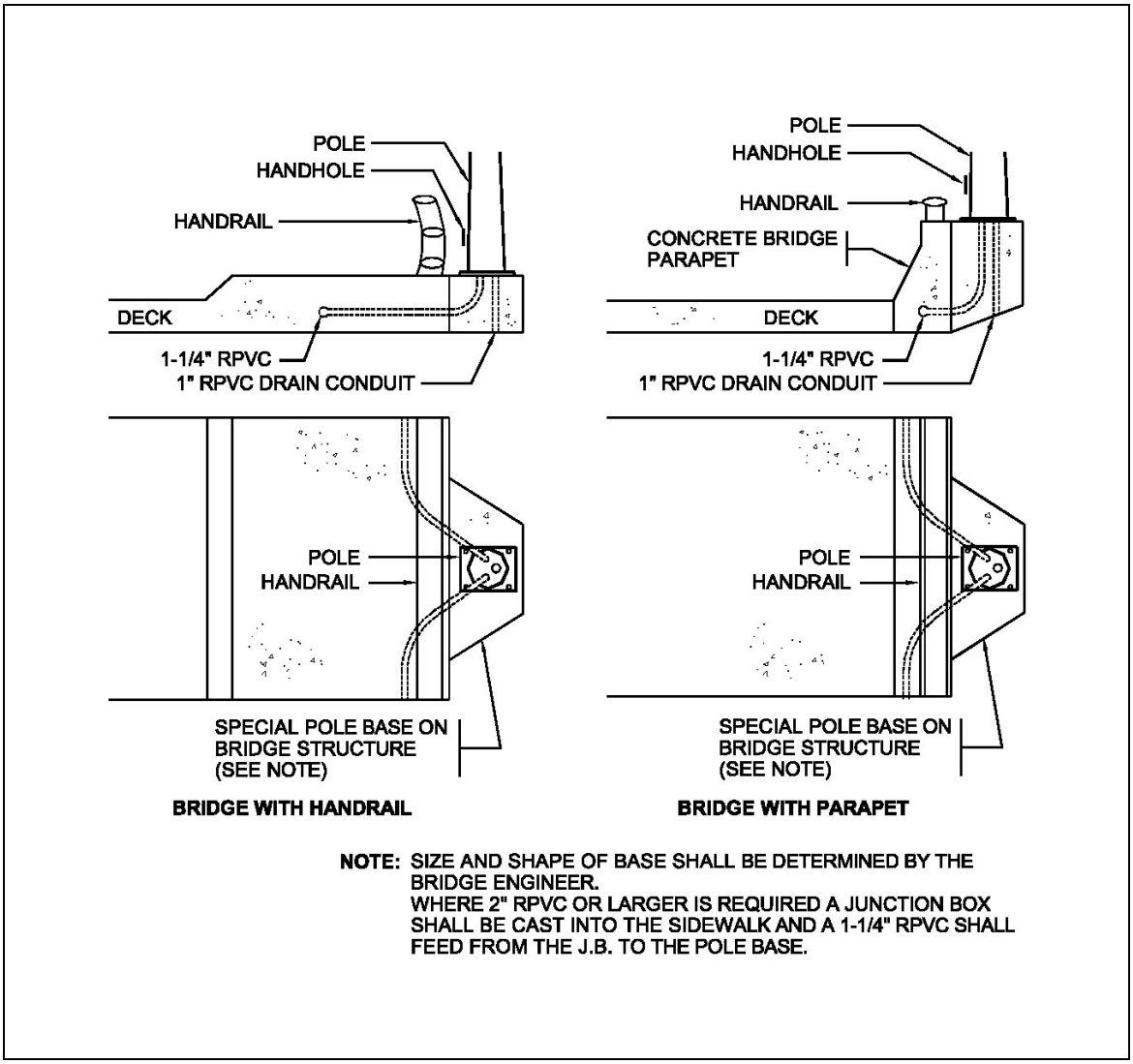


Figure 26: Typical Luminaire Pole Mounting on Bridge Structures

14. PEDESTRIAN WALKWAY, PATHWAY AND BIKEWAY LIGHTING

14.1 GENERAL

The purpose of pedestrian walkway, pathway and bikeway lighting is to provide for night time vision. Where a walkway is considered the primary access to residence, the lighting shall be designed as a Walkway/ Emergency Access and lighting is to be designed following the Design Guidelines for Subdivision Servicing

14.2 PEDESTRIAN WALKWAY, PATHWAY & BIKEWAY LIGHTING WARRANTS

Lighting for pedestrian walkways, pathways and bikeways (i.e. separate from the roadway lighting and with no potential for vehicle/pedestrian conflicts) is required in the following circumstances:

- Ramps to pedestrian overpasses
- Locations with stairs more than 2 risers high
- Walkways and pathways in known high security areas as determined by the public safety authorities
- Where Calgary Transit has designated pedestrian walkways and pathways as “Transit Pedestrian Corridors”
- Where a pathway exists between residences, connecting two roadways and is greater than 50m. Lighting levels do need to be achieved in this application. A 50m pole spacing is suggested

14.3 PEDESTRIAN WALKWAY, PATHWAY & BIKEWAY LIGHTING MATERIALS

Walkways, pathways and bikeways requiring a separate lighting system are generally illuminated with City standard LED post top luminaires mounted on 5.0m poles. However, decorative style HPS, metal halide, or LED luminaires may also be considered. Glare shields shall be used to reduce or eliminate light trespass and glare with respect to adjacent residences.

Luminaires and poles shall be as provided in the list of City Approved Street Lighting Luminaires. For a copy of the list, please contact The City Street Light Design Team.

14.4 PEDESTRIAN WALKWAY, PATHWAY & BIKEWAY LIGHTING DESIGN

Recommended lighting design criteria for pedestrian walkways, pathways and bikeways associated with public road right-of-way are detailed in IES RP-8 Tables 4, 5, 6, and 7.

If a walkway or bikeway runs adjacent to a roadway lighting system, lighting designers shall determine whether spill lighting from the roadway lighting system provides adequate lighting on the walkway.

14.5 PEDESTRIAN WALKWAY, PATHWAY & BIKEWAY LIGHTING LAYOUT

The typical pathway and bikeway lighting luminaire spacing is shown in Figure 27 below is to be considered as a guide only. Final pole spacing shall be confirmed by computer design, and approved by the City Senior Street Lighting Engineer.

The required setback from the edge of the pathway or bikeway to the face of the pole is 1.0m and must be achieved. Where available space does not permit the 1.0m offset to be achieved and clear zone requirements to be met, the clear zone may be reduced by 0.25m. Breakaway bases will be used in this instance when directed by The City.

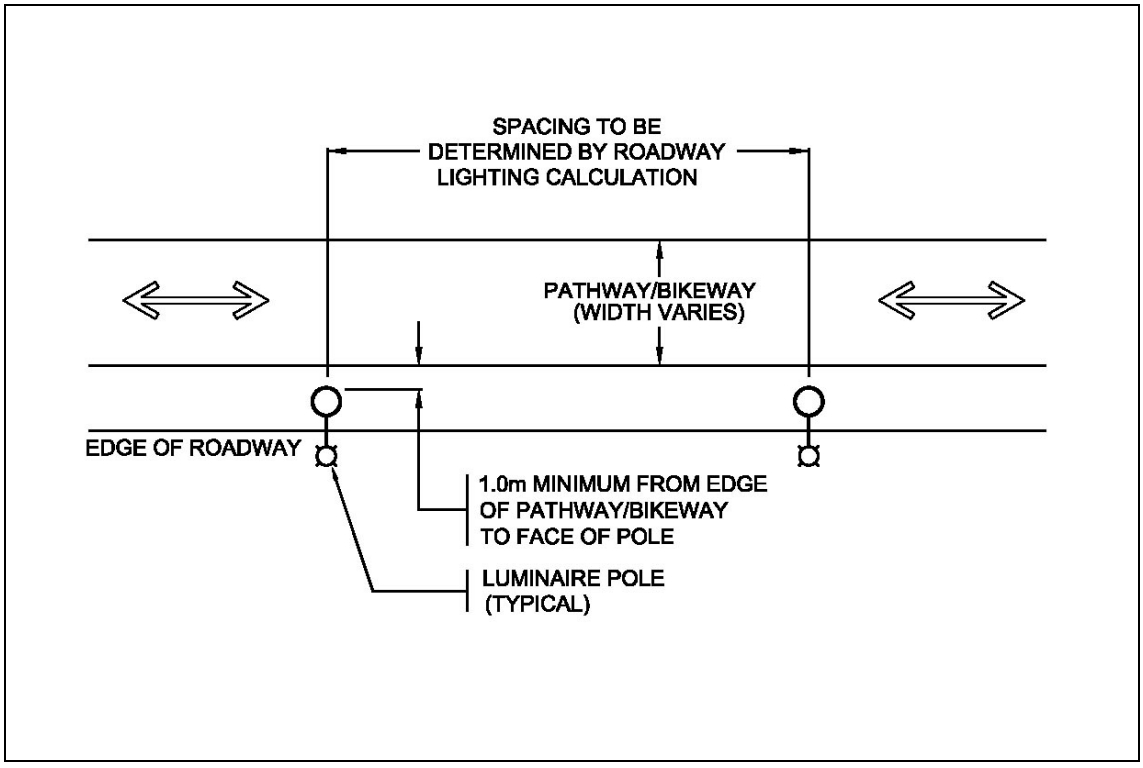


Figure 27: Typical Pathway or Bikeway Lighting

The typical walkway lighting luminaire spacing is shown in Figure 28 below is to be considered as a guide only. Final pole spacing shall be confirmed by computer modeling, and approved by The City Senior Street Lighting Engineer.

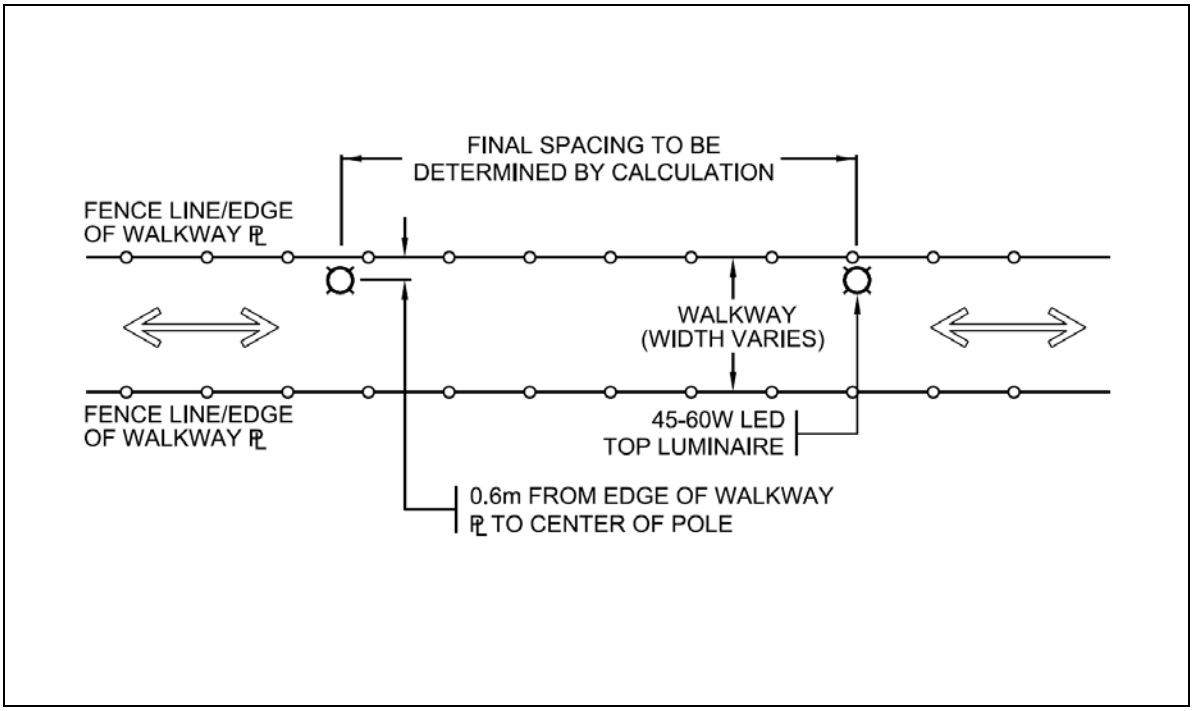


Figure 28: Typical Walkway Lighting

15. CONSTRUCTION DETOUR &TRANSITION ZONE LIGHTING

15.1 GENERAL

Refer to Section 3 – Lighting Design for construction detour and transition zone general lighting design criteria.

15.2 CONSTRUCTION DETOUR & TRANSITION ZONE LIGHTING WARRANTS

In the City of Calgary, lighting is required at all temporary construction detours where roadway lighting existed before the detour.

Lighting is required at detours, as determined by the City Senior Street Lighting Engineer, where one of the following conditions exists:

- The road geometry is overly complex
- There is a medium to high level of night time pedestrians
- Safety is a concern

Lighting is only required at detours that will be in use during night time hours.

The above warrants apply to lighting for vehicular and pedestrian traffic only. These are not warrants for task lighting that may be required for night time construction work. The lighting for construction work is the contractors' responsibility and is regulated by the Occupational Health and Safety Act.

15.3 CONSTRUCTION DETOUR & TRANSITION ZONE LIGHTING MATERIALS

All lighting materials used for temporary lighting shall as provided in the list of City Approved Street Lighting Luminaires. For a copy of the list, please contact The City Street Light Design Team. If it is impractical to use the City approved lighting equipment for the temporary lighting, a temporary wood pole system with overhead wiring is permissible. All luminaires used must be flat glass cobra head to provide appropriate glare control.

Floodlights are not permissible for temporary detour lighting unless it can be shown to the City Senior Street Lighting Engineer's satisfaction that proper glare and light pollution control can be achieved.

15.4 CONSTRUCTION DETOUR & TRANSITION ZONE LIGHTING DESIGN

All lighting designs for temporary construction detours and transition zones must meet the roadway lighting design requirements as defined in Section 7 – Roadway Lighting, Section 8 – Intersection Lighting and Section 9 – Interchange Lighting, including the secondary criteria such as uniformity spill light and glare.

Where possible, construction detour and transition zone lighting shall be provided in whole, or in part, by the permanent lighting installation of the project. This can many times be achieved by the early installation of the electrical systems in a project.

Where construction detour and transition zone lighting cannot be provided by the permanent lighting installation, must be supplemented by additional lighting. All lighting materials used for temporary lighting shall be from the Approved Street Lighting Luminaire list, and then subsequently be re-used as part of the permanent installation elsewhere in the project.

To ensure safety, roadway lighting on temporary construction detours may require higher lighting levels than those noted in IES RP-8. Issues such as speed, road geometrics, number of detour stages, proximity of roadside hazards, volume of traffic, and driver safety will affect detour lighting levels.

If lighting of temporary construction detours is required (as outlined in Section 15.2), the design criteria for the class of roadway in question shall be selected, and the required lighting level increased by 50%. (This is based on the principle outlined in IES RP-8 Paragraph 5.1.3, which recommends increasing roadway lighting levels by 50% for special traffic conflict areas).

The determined lighting levels for temporary construction detours shall be confirmed with the City Senior Street Lighting Engineer prior to proceeding with the detailed design.

These construction lighting recommendations apply to lighting for vehicular and pedestrian traffic only. These are not recommendations for task lighting that may be required for night time construction work. Lighting specifically for construction work is the contractors' responsibility and is regulated by Occupational Health and Safety.

15.5 CONSTRUCTION STAGING

In the City of Calgary, existing street lighting must be maintained throughout the duration of construction.

The lighting designers shall review construction staging designs and schedules, and shall insure that the required street lighting is in place through all stages of the construction.

16. DESIGN SUBMISSIONS

Design submissions made to The City should include but is not limited to the following information with the purpose to provide all relevant information to aid design review.

The lighting designers must include the project AGI32 design file(s) in PDF format, as part of all design folder submissions to prove the validity of the lighting design results.

The IES formatted photometrics for the luminaire(s) used shall be provided electronically or external hard drive with the project design file(s), for special considerations.

The lighting designers are encouraged to include, as a minimum, all correspondence related to:

1. Confirmation of design requirements
2. Confirmation of electrical service location by Enmax
3. All correspondence with Roads
4. Any other correspondence that, in the opinion of the lighting designers, provides support to the street lighting design submitted

All street lighting designs submitted to The City for approval shall be signed and sealed by an APEGA Registered Professional Engineer. This requirement shall only apply to final design submissions.

Designs must make use of materials (poles, fixtures, bases, conduit, relays, etc) utilized by The City. Non City material designs will NOT be approved.

16.1 INFORMATION FIELDS

A. Project Information (REQUIRED – all submissions)

B. Project Contact List (REQUIRED – all submissions)

C. Design Requirements & Summary Sheets (REQUIRED – all submissions)

D. Verification of Lighting Levels (REQUIRED – all submissions)

E. Load Calculations (REQUIRED – all submissions)

F. Voltage Drop Calculation (REQUIRED – final submission only)

G. Engineers Construction Estimate (REQUIRED – final submission only)

H. Material List (REQUIRED – final submission only)

I. Site Pictures (OPTIONAL)

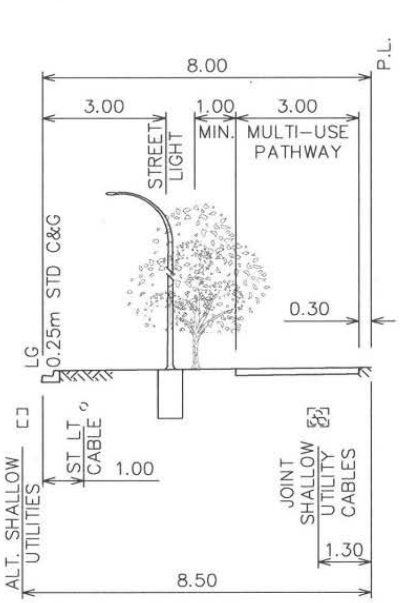
16.2 ENGINEERS CONSTRUCTION COST ESTIMATE

The construction cost estimate for the street lighting project shall be prepared in a “unit price” format, and shall be of sufficient detail to clearly identify the various

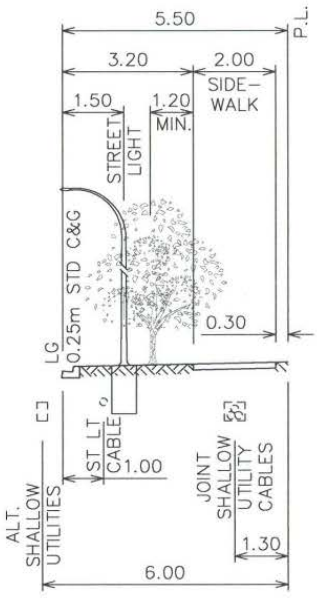
distinct items of the work. The format to be used shall be left to the lighting designers, but it is suggested that this format be submitted to The City for review and approval.

APPENDIX A: TYPICAL ROADWAY CROSS-SECTIONS

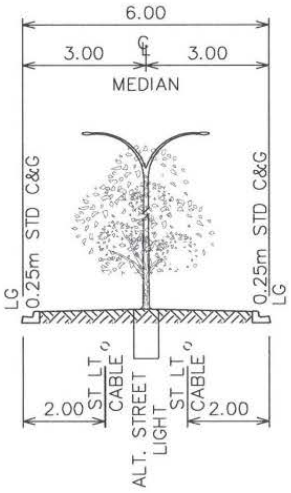
(From Design Guidelines for Subdivision Servicing 2014)



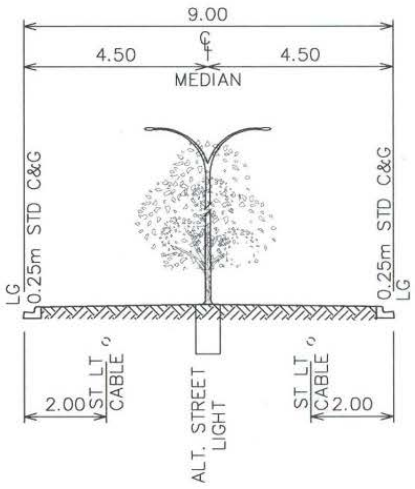
WITH MULTI-USE PATHWAY



WITH SEPARATE SIDEWALK



MEDIAN - 4 LANES



MEDIAN - 6 LANES

THE CITY OF CALGARY ROADS

DIMENSIONS ARE MILLIMETRES UNLESS OTHERWISE NOTED METRIC

PERMIT

PERMIT TO PRACTICE
THE CITY OF CALGARY
Signature :
Date : 2015 Mar 17
PERMIT NUMBER : P 4428
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

SEAL

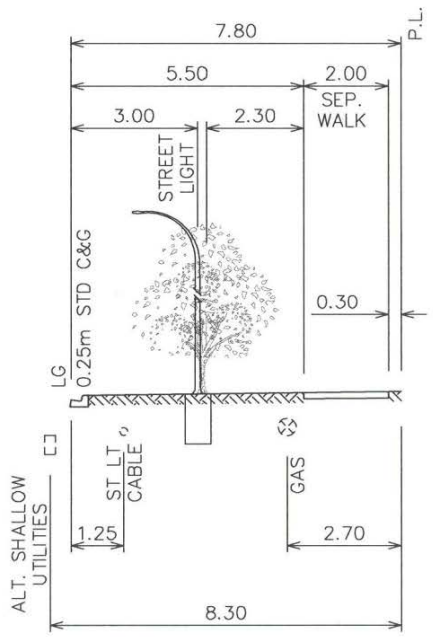
PROFESSIONAL ENGINEER ALBERTA
2015/03/01

CROSS SECTION ARTERIAL STREET

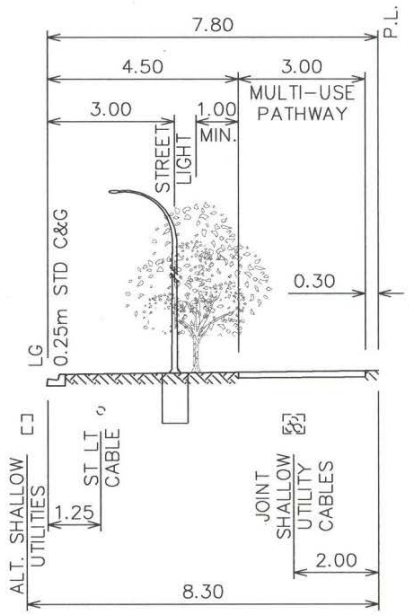
NO.	REVISION	DATE
–	–	–

DES: AH (2015-02-17)
DWN: JA (2015-03-05)
SCALE: NTS
FIGURE 1

O:\tran\streetlight\spec_sheets\2015\2015 Spec Cross Section Updates\01_Arterial St_4 Lanes.dwg, 3/11/2015 2:03:00 PM, 1:1



WITH SEPARATE SIDEWALK



WITH MULTI-USE PATHWAY

DIMENSIONS ARE MILLIMETRES UNLESS OTHERWISE NOTED METRIC

THE CITY OF CALGARY ROADS

PERMIT

PERMIT TO PRACTICE
THE CITY OF CALGARY
Signature :
Date :
PERMIT NUMBER : P 4428
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

SEAL

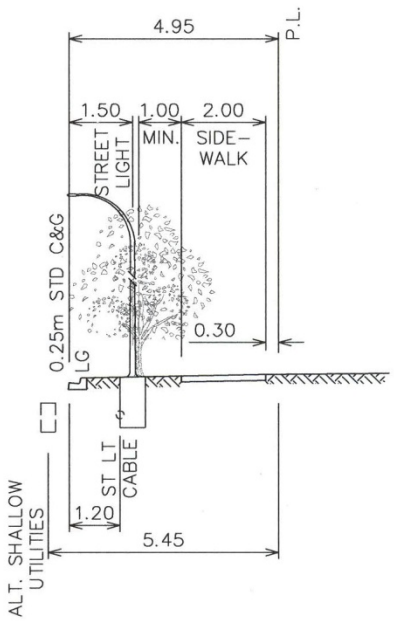
PROFESSIONAL ENGINEERS ALBERTA
2015/05/01

CROSS SECTION
INDUSTRIAL ARTERIAL STREET

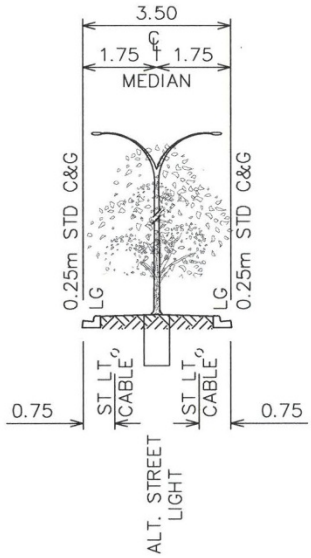
NO.	REVISION	DATE
-	-	-

DES: AH (2015-02-17)
DWN: JA (2015-02-17)
SCALE: NTS
FIGURE 2

O:\tran\streetlight\spec_sheets\2015\2015 Spec Cross Section Updates\02_Industrial Arterial St.dwg, 3/10/2015 1:36:46 PM, 1:1



WITH SEPARATE SIDEWALK



MEDIAN

DIMENSIONS ARE MILLIMETRES UNLESS OTHERWISE NOTED METRIC

THE CITY OF CALGARY ROADS

PERMIT

PERMIT TO PRACTICE
THE CITY OF CALGARY
Signature :
Date : 2015 May 7
PERMIT NUMBER : P 4428
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

SEAL

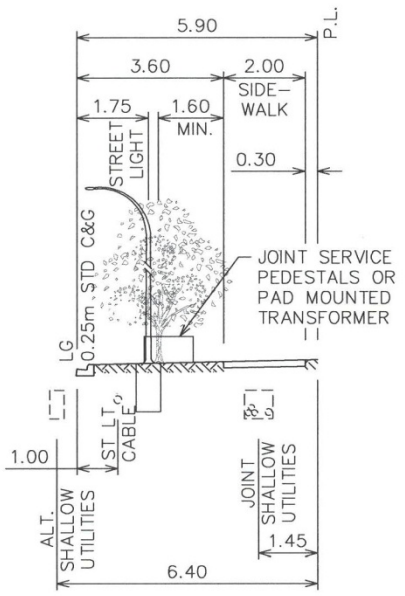
PROFESSIONAL ENGINEER ALBERTA
2015/05/01

CROSS SECTION
LOCAL ARTERIAL STREET

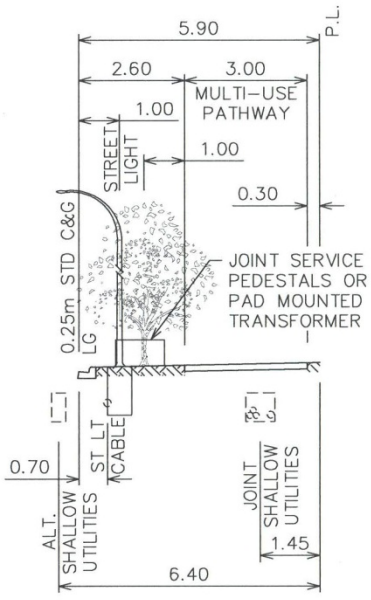
NO.	REVISION	DATE
--	-	--

DES: AH (2015-02-17)
DWN: JA (2015-03-03)
SCALE: NTS
FIGURE 3

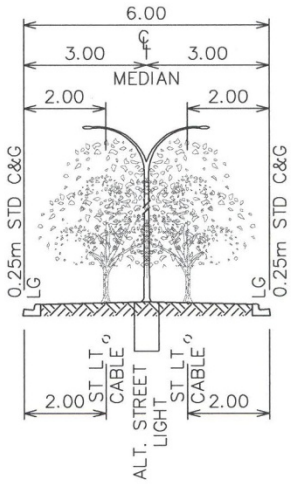
O:\tran\streetlight\spec_sheets\2015\2015 Spec Cross Section Updates\03_Local Arterial St.dwg, 3/11/2015 2:06:46 PM, 1:1



WITH SEPARATE SIDEWALK



WITH MULTI-USE PATHWAY



MEDIAN

DIMENSIONS ARE MILLIMETRES UNLESS OTHERWISE NOTED METRIC

THE CITY OF CALGARY ROADS

PERMIT

PERMIT TO PRACTICE
THE CITY OF CALGARY
Signature :
Date : 2015 Mar 17
PERMIT NUMBER : P 4428
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

SEAL

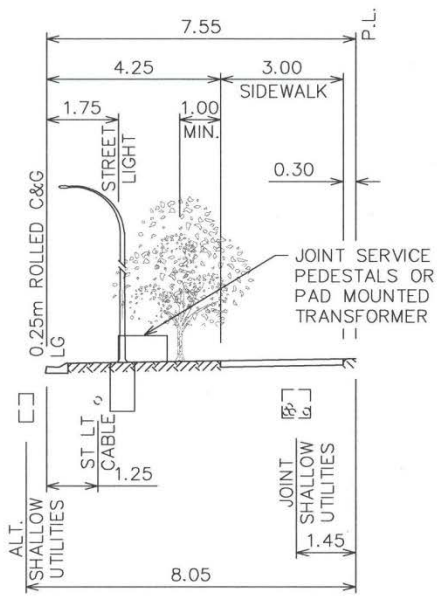
PROFESSIONAL ENGINEER ALBERTA
2015/03/01

CROSS SECTION PARKWAY

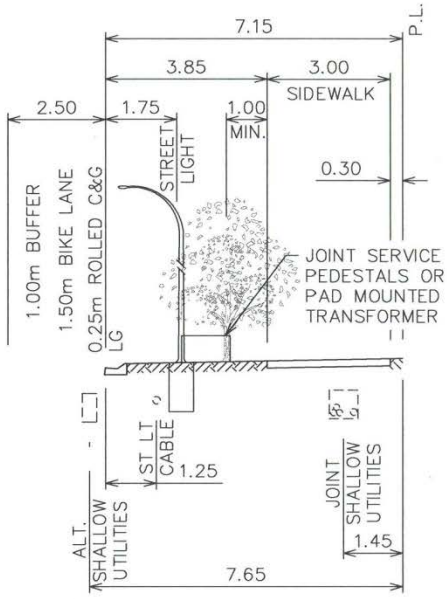
NO.	REVISION	DATE
-	-	-

DES: AH (2015-02-17)
DWN: JA (2015-02-18)
SCALE: NTS
FIGURE 4

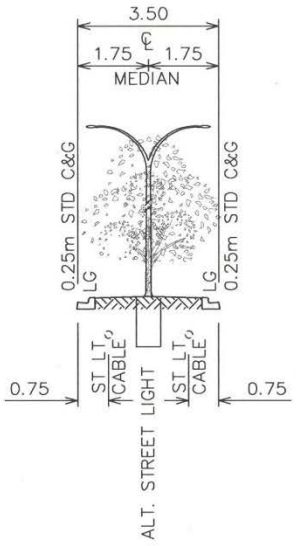
O:\tran\streetlight\spec_sheets\2015\2015 Spec Cross Section Updates\04_Parkway.dwg, 3/10/2015 2:10:40 PM, 1:1



WITH 7.55m BOULEVARD



WITH 7.15m BOULEVARD



MEDIAN

DIMENSIONS ARE MILLIMETRES UNLESS OTHERWISE NOTED METRIC

THE CITY OF CALGARY ROADS

PERMIT

PERMIT TO PRACTICE
THE CITY OF CALGARY
Signature :
Date : 2015 MAR 17
PERMIT NUMBER : P 4428
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

SEAL

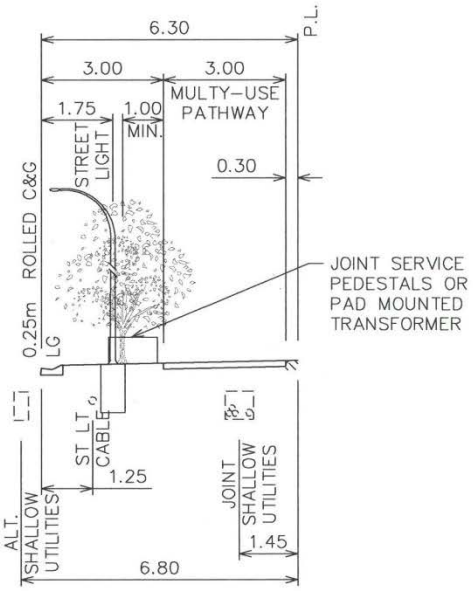
PROFESSIONAL ENGINEER PROVINCE OF ALBERTA
2015/03/01

CROSS SECTION URBAN BOULEVARD

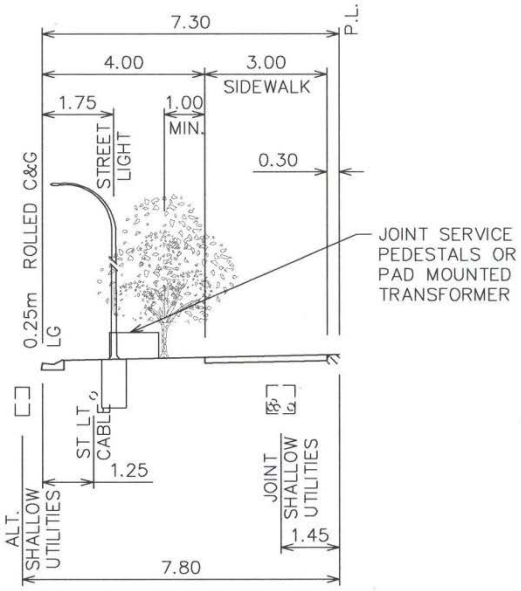
NO.	REVISION	DATE
-	-	-

DES: AH (2015-02-17)
DWN: JA (2015-03-03)
SCALE: NTS
FIGURE 5

O:\tran\streetlight\spec_sheets\2015\2015 Spec Cross Section Updates\05_Urban Boulevard.dwg, 3/11/2015 2:07:48 PM, 1:1



WITH 6.30m BOULEVARD



WITH 7.30m BOULEVARD

DIMENSIONS ARE MILLIMETRES UNLESS OTHERWISE NOTED — METRIC

THE CITY OF CALGARY ROADS

PERMIT

PERMIT TO PRACTICE
THE CITY OF CALGARY
Signature :
Date : 2015 May 17
PERMIT NUMBER : P 4428
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

SEAL

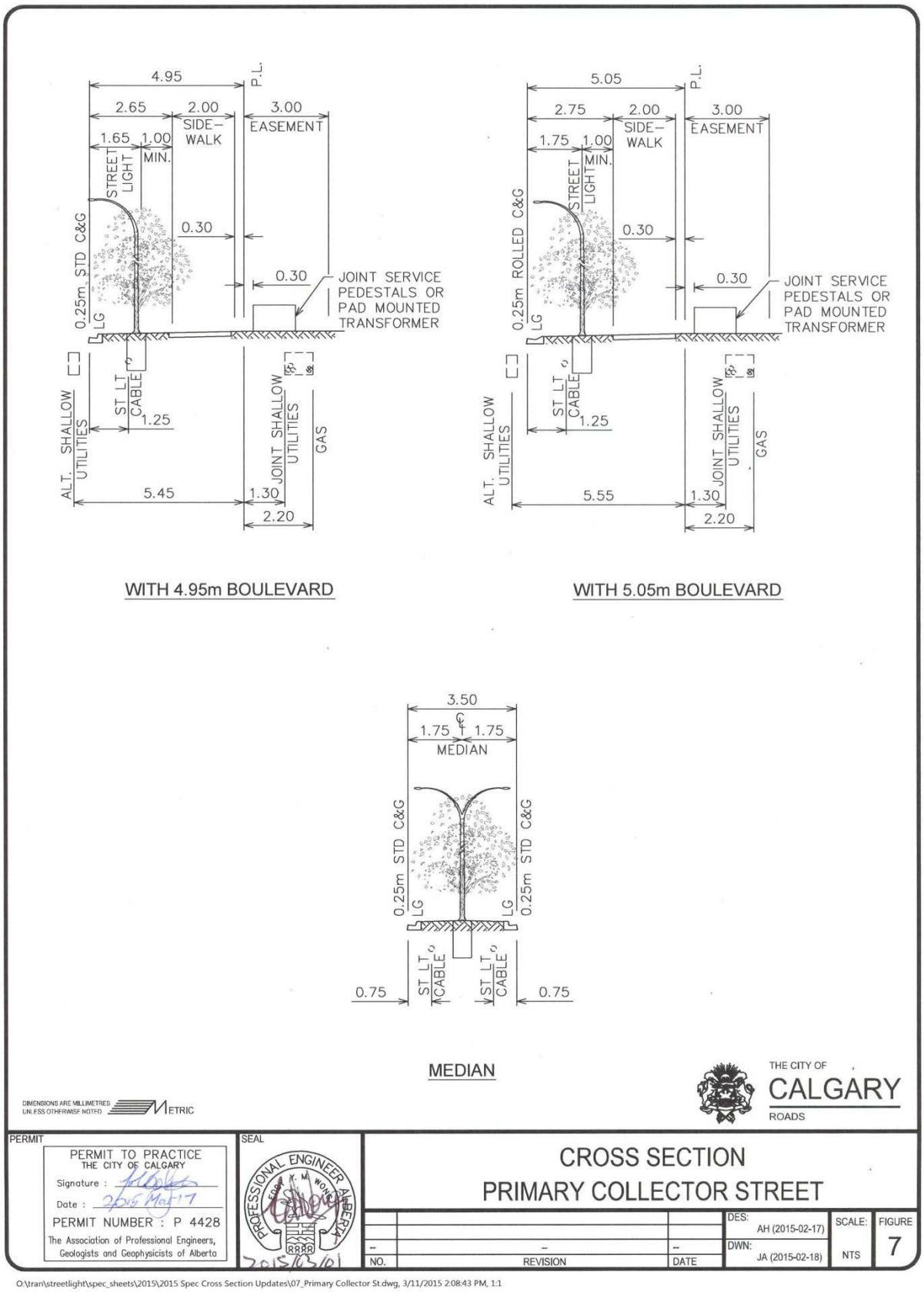
PROFESSIONAL ENGINEER ALBERTA
RRRR
2015/03/01

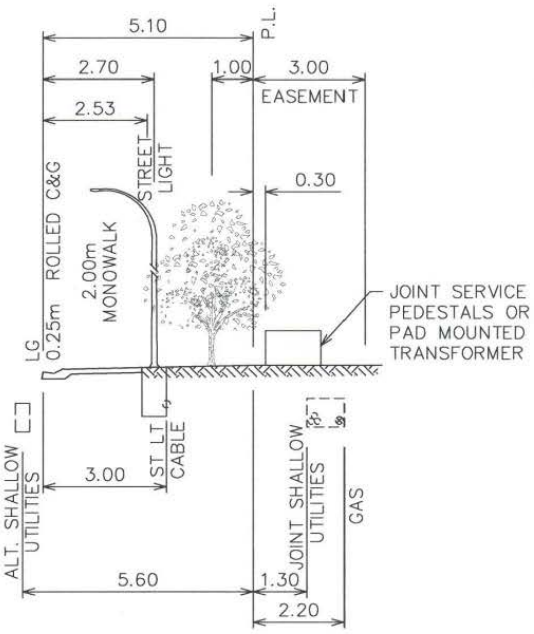
CROSS SECTION
NEIGHBOURHOOD BOULEVARD

NO.	REVISION	DATE
-	-	-

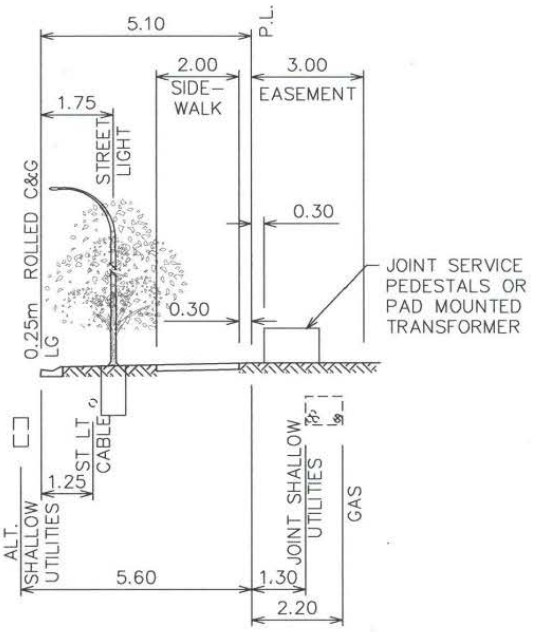
DES: AH (2015-02-17)
DWN: JA (2015-02-18)
SCALE: NTS
FIGURE 6

O:\tran\streetlight\spec_sheets\2015\2015 Spec Cross Section Updates\06_Neighbourhood Boulevard.dwg, 3/10/2015 2:36:01 PM, 1:1


4.95
P.L.
2.65
2.00
SIDE-WALK
3.00
EASEMENT
1.65
1.00
MIN.
STREET LIGHT
0.30
0.30
JOINT SERVICE PEDESTALS OR PAD MOUNTED TRANSFORMER
0.25m STD C&G
LG
ST LT CABLE
1.25
ALT. SHALLOW UTILITIES
JOINT SHALLOW UTILITIES
GAS
5.45
1.30
2.20
WITH 4.95m BOULEVARD
5.05
P.L.
2.75
2.00
SIDE-WALK
3.00
EASEMENT
1.75
1.00
MIN.
STREET LIGHT
0.25m ROLLED C&G
LG
0.30
0.30
JOINT SERVICE PEDESTALS OR PAD MOUNTED TRANSFORMER
ST LT CABLE
1.25
ALT. SHALLOW UTILITIES
JOINT SHALLOW UTILITIES
GAS
5.55
1.30
2.20
WITH 5.05m BOULEVARD
3.50
1.75
1.75
MEDIAN
0.25m STD C&G
LG
0.25m STD C&G
LG
ST LT CABLE
ST LT CABLE
0.75
0.75
MEDIAN
DIMENSIONS ARE MILLIMETRES UNLESS OTHERWISE NOTED
METRIC
THE CITY OF CALGARY ROADS
PERMIT
PERMIT TO PRACTICE
THE CITY OF CALGARY
Signature :
Date : 2015 May 17
PERMIT NUMBER : P 4428
The Association of Professional Engineers, Geologists and Geophysicists of Alberta
SEAL
PROFESSIONAL ENGINEER
PROVINCE OF ALBERTA
2015/03/01
CROSS SECTION
PRIMARY COLLECTOR STREET
NO.
REVISION
DATE
DES: AH (2015-02-17)
DWN: JA (2015-02-18)
SCALE: NTS
FIGURE 7
O:\tran\streetlight\spec_sheets\2015\2015 Spec Cross Section Updates\07_Primary Collector St.dwg, 3/11/2015 2:08:43 PM, 1:1



WITH MONOLITHIC SIDEWALK



WITH SEPARATE SIDEWALK

DIMENSIONS ARE MILLIMETRES UNLESS OTHERWISE NOTED — METRIC

THE CITY OF CALGARY ROADS

PERMIT

PERMIT TO PRACTICE
THE CITY OF CALGARY
Signature :
Date : 2015 Mar 17
PERMIT NUMBER : P 4428
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

SEAL

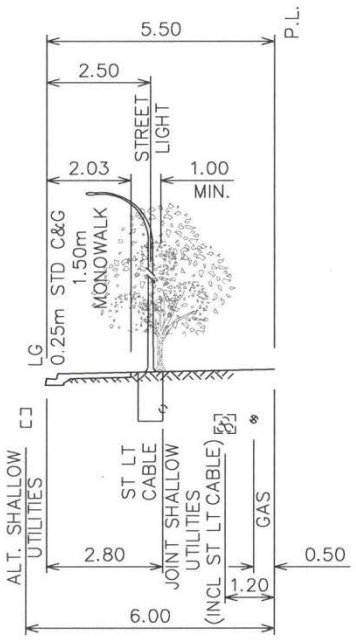
PROFESSIONAL ENGINEER ALBERTA
2015/03/01

CROSS SECTION COLLECTOR STREET

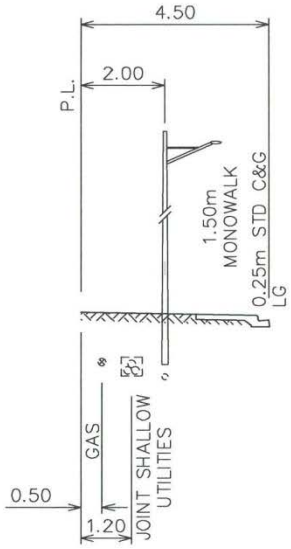
NO.	REVISION	DATE
--	--	--

DES: AH (2015-02-17)
DWN: JA (2015-02-18)
SCALE: NTS
FIGURE 8

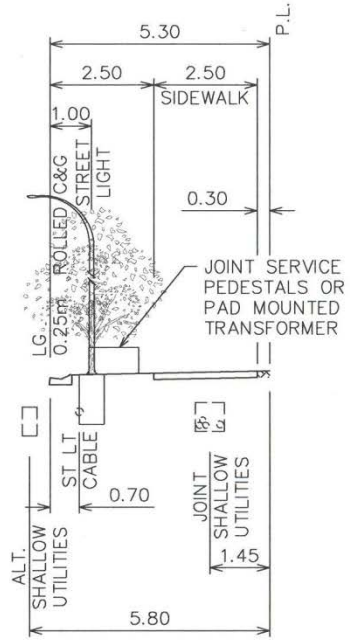
O:\tran\streetlight\spec_sheets\2015\2015 Spec Cross Section Updates\08_Collector St.dwg, 3/10/2015 2:48:43 PM, 1:1



INDUSTRIAL STREET



INDUSTRIAL STREET
BASE WITH OVERHEAD POWER POLE



ACTIVITY CENTRE STREET

DIMENSIONS ARE MILLIMETRES UNLESS OTHERWISE NOTED METRIC

THE CITY OF CALGARY ROADS

PERMIT

PERMIT TO PRACTICE
THE CITY OF CALGARY
Signature :
Date : 2015 MAR 17
PERMIT NUMBER : P 4428
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

SEAL

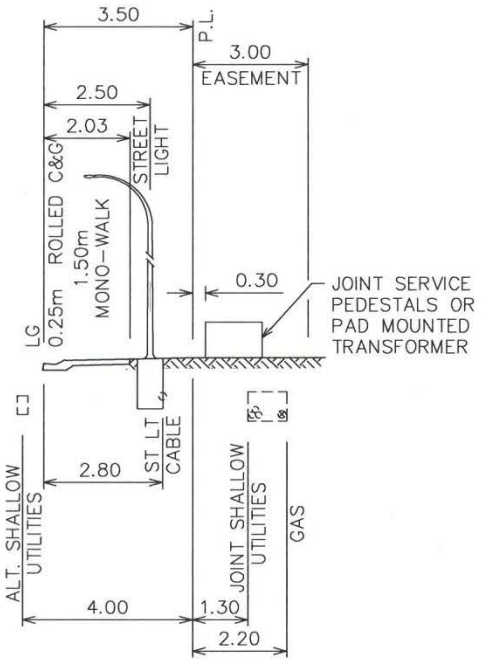
PROFESSIONAL ENGINEER ALBERTA
2015/03/01

CROSS SECTION
INDUSTRIAL & ACTIVITY CENTRE STREETS

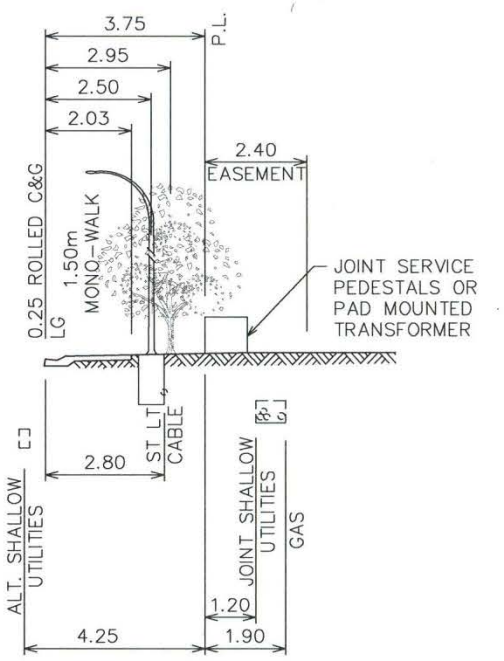
NO.	REVISION	DATE
--	-	--

DES: AH (2015-02-17)
DWN: JA (2015-02-18)
SCALE: NTS
FIGURE 9

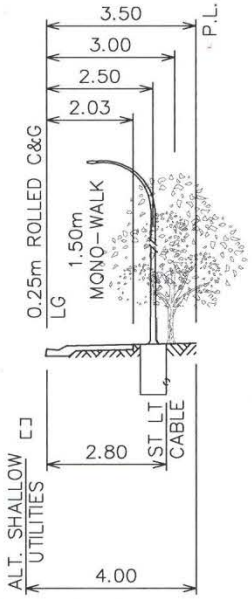
O:\tran\streetlight\spec_sheets\2015\2015 Spec Cross Section Updates\09_Activity Centre and Indust.dwg, 3/11/2015 2:17:17 PM, 1:1



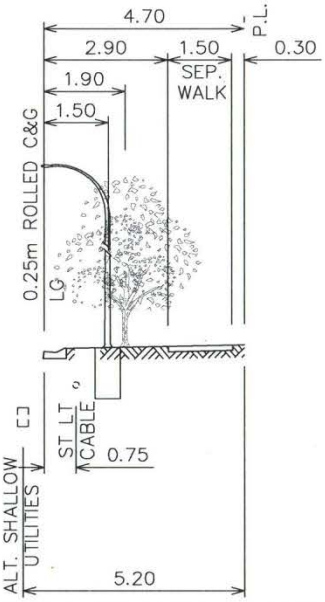
RESIDENTIAL ENTRANCE STREET



RESIDENTIAL STREET "M"
MONO-WALK, NO REAR LANE



RESIDENTIAL STREET "M-L"
MONO-WALK WITH REAR LANE



RESIDENTIAL STREET "SW-L"
SEPARATE-WALK WITH REAR LANE

DIMENSIONS ARE MILLIMETRES UNLESS OTHERWISE NOTED — METRIC

THE CITY OF CALGARY ROADS

PERMIT

PERMIT TO PRACTICE
THE CITY OF CALGARY
Signature :
Date : 2015 Mar 17
PERMIT NUMBER : P 4428
The Association of Professional Engineers, Geophysicists of Alberta

SEAL

PROFESSIONAL ENGINEER ALBERTA
EDGE Y. M. WONG
2015/03/101

CROSS SECTION
RESIDENTIAL STREET

NO.	REVISION	DATE
–	–	–

DES: AH (2015-02-17)
DWN: JA (2015-02-18)
SCALE: NTS
FIGURE 10

O:\tran\streetlight\spec_sheets\2015\2015 Spec Cross Section Updates\10_Residential Street.dwg, 3/11/2015 2:37:12 PM, 1:1

APPENDIX B: STREET LIGHTING DRAFTING STANDARDS

Layers, Symbology, and Procedures

B1. INTRODUCTION TO DRAFTING STANDARDS

B1.1 About the Drafting Standards

This describes drafting standards that were established to create consistent presentation for all street lighting design and installation drawings.

All drawings shall be produced using a computer aided drafting software program. Drawings shall not be manually produced.

The purpose for the exclusive use of computer aided drafting software for the street lighting design drawings is to allow The City to:

- Maintain and develop established drafting standards, ensuring consistent drawing quality and integrity
- Retrieve and revise existing drawings due to ongoing lighting system upgrades and additions undertaken by Calgary Roads
- Maintain the existing street lighting system records to ensure accessibility and continuity
- Digitize older, hand drafted street lighting drawings for insertion into The City's records system

B1.2 Before You Begin

The draftspersons shall use one of the following computer aided drafting software programs when generating street lighting design drawings:

- AutoCAD 2000 or newer issue
- Microstation Version SE or newer issue

Draftspersons shall confirm the current version the computer aided drafting software being used by the City of Calgary, Roads.

Digital files are to be submitted to Roads in the following manner:

- Microstation – in Version SE only
- AutoCAD – as an AutoCAD 20007 – 2013 DXF format file

Roads require that all drawings use standard symbols and details. A hard copy of the library symbols of Appendix B.

A sample project depicting the presentation of a completed street lighting design and installation drawing is located at the end of Appendix B.

B2. DRAWING LAYERS

B2.1 General

Required drawing layering for Roads street lighting drawings provided in Appendix B. The requirements for Microstation and AutoCAD are not necessarily the same. The draftspersons shall insure that the correct information is used in drawing preparation.

B2.2 Drawing Layers - AutoCAD

The layer colours and pen weights for the street lighting drawings generated in AutoCAD are defined through the AutoCAD “BYLAYER” option; this is the only method to be used for layering. This will ensure all entities are placed on their proper layers.

Pen to line weight parameters shall be as defined in Table 9 below. Refer to Table 10 below for a complete listing of all drawing layer names.

Table 9: Pen to Line Weight Parameters

Pen No./Colour	Pen Width	Shading
1(Red)	0.25mm	100%
2(Yellow)	0.35mm	100%
3(Green)	0.55mm	100%
4(Cyan)	0.70mm	100%
5(Blue)	0.25mm	100%
6(Magenta)	0.20mm	100%
7(White)	0.25mm	100%
8(Grey)	0.25mm	100%
9(Light Grey)	0.25mm	100%
10(Light Red)	0.25mm	40%
11(Salmon)	0.25mm	40%
12(Brown)	0.25mm	40%
13(Light Brown)	0.25mm	40%
14(Dark Brown)	0.25mm	40%
15(Deep Brown)	0.25mm	40%
16 to 250(Varies)	0.25mm	40%
251(Dark Grey)	0.25mm	0%

Table 10: Standard Drawing Layers

Layer	Color	Line Type	Examples of Use
0	7	Continuous	Construction Lines
CRE11CIVU	11	*varies	Underground objects that may affect the design
CRE11CIV	11	*varies	Above ground objects that may affect the design
CRECTEXT	4	Continuous	>2.5mm high text
CREGTEXT	3	Continuous	2.5mm high text
CREYTEXT	2	Continuous	2.0mm high text
CRECRPVC	4	RPVC	Proposed RPVC electrical conduit
CRECHDPE	4	HDPE	Proposed HDPE electrical conduit
CREYRPVC	2	RPVC	Existing RPVC electrical conduit
CREYHDPE	2	HDPE	Existing HDPE electrical conduit
CRECCOM	4	Communication	Proposed communications conduit
CREYCOM	2	Communication	Existing communications conduit
CREYCAR	2	Carlon	Existing carlon and conductors
CRECCO	4	Continuous	Concrete base symbols
CREGCO	3	Continuous	Luminaire symbols
CREYCO	2	Continuous	Solid fill in symbols and Elevations
CRERCO	1	Continuous	Concrete symbol in elevations
CRECHI	4	Hidden	Hidden conduit
CREYHI	2	Hidden	Hidden objects
CREYDA	2	Dashed	Concrete bases in elevation
CREYSM	2	Small Dots	Equipment to be removed
CREYOH	2	OH	Overhead conductors
CRGCO	3	Continuous	Legal property lines, station line
CRYCO	2	Continuous	Lot lines, curb, sidewalk, wheel chair ramps, edge of pavement
CRRCO	1	Continuous	Gutter, Solid Paint Lines
CRYFUT	2	Future	Future roadworks
CRRCE	1	Center	Center lines
CRRDA	1	Dashed	Dashed paint lines
CRRPAINT	1	Paint	Lane lines
CRCTEXT	4	Continuous	Road Names
CRGTEXT	3	Continuous	Legal descriptions
CRYTEXT	2	Continuous	Lot Numbers
CRE251	251	Continuous	Wipeouts, mviews
CRRPAINT	1	Paint	Roadway

*Layers CRE11CIVU and CRE11CIV are permitted to have multiple line types.

Any underground utilities (electrical, telephone, gas, water, sewer, drainage, etc.) or other objects identified on the civil drawings shall be included on layer “CRE11CIVU”.

Above ground objects (trees, houses, etc.) shall be included on layer “CRE11CIV”.

B2.3 Drawing Layers – Microstation

The layer colours for the street lighting drawings generated in Microstation are defined in the City of Calgary Standard Block Profile Specifications; this is the only method to be used for layering. This will ensure all entities are placed on their proper layers.

B3. DRAWING LINE TYPES

B3.1 General

The required drawing line types for street lighting drawings are described in this section. The requirements for Microstation and AutoCAD are not necessarily the same. The draftspersons shall insure that the correct information is used in drawing preparation.

B3.2 Drawing Line Types - AutoCAD

For examples of line types to be used on street lighting drawings, see Table 11 below. A digital line file for these AutoCAD line types may be obtained from The City. They will be provided with the standard specifications.

The global line type scale factor of 1.0 is used in all street lighting drawings.

Table 11: Standard Drawing Line Types

LINE TYPE NAME	EXAMPLE
CENTER	
COMMUNICATION	
DASHED	
HIDDEN	
FUTURE	
RPVC	
HDPE	
O/H	
SMDOTS	
PAINT-500	

B3.3 Drawing Line Types - Microstation

The line types for the street lighting drawings generated in Microstation are defined in the City of Calgary Standard Block Profile Specifications; this is the only method to be used for line types. This will ensure all entities are placed on their proper layers.

B4. BLOCK LIBRARY

B4.1 General

The street lighting symbol blocks required to generate street lighting drawings are described in this section. The block requirements for Microstation and AutoCAD are not necessarily the same. The draftspersons shall insure that the correct information is used in drawing preparation.

B4.2 Symbol Blocks - AutoCAD

For examples of the symbol blocks to be used on street lighting drawings generated in AutoCAD, see drawing DS/DL-BL sheets 1 and 2 at the end of this section. Note that the required Roads standard drawing sheet is a block that shall be used. Digital CAD files of these AutoCAD symbol blocks may be obtained from The City, upon request.

B4.3 Symbol Blocks - Microstation

For examples of the symbol blocks to be used on street lighting drawings generated in Microstation, see the City of Calgary Standard Block Profile Specifications.

BLOCK	SYMBOL	DESCRIPTION
(CR3H)		PROPOSED HIGHMAST STREETLIGHT POLE (3 LUMINAIRE)
(CR4H)		PROPOSED HIGHMAST STREETLIGHT POLE (4 LUMINAIRE)
(CRSD)		PROPOSED LUMINAIRE POLE
(CRDD)		PROPOSED DOUBLE DAVIT STREETLIGHT POLE
(CRPTS)		PROPOSED STREETLIGHT ON PROPOSED TRAFFIC SIGNAL POLE
(CRETSPL)		PROPOSED STREETLIGHT ON EXISTING TRAFFIC SIGNAL POLE
(CRETS)		EXISTING STREETLIGHT ON EXISTING TRAFFIC SIGNAL POLE
(CRE3H)		EXISTING HIGHMAST STREETLIGHT POLE (3 LUMINAIRE)
(CRE4H)		EXISTING HIGHMAST STREETLIGHT POLE (4 LUMINAIRE)
(CREDD)		EXISTING DOUBLE DAVIT STREETLIGHT POLE
(CRESD)		EXISTING DAVIT STREETLIGHT POLE
(CRPFL)		PROPOSED FLOOD LIGHT
(CREFL)		EXISTING FLOOD LIGHT
(CRBB)	B	DENOTES BREAKAWAY BASE
(CRFB)	F	DENOTES FRANGIBLE BASE

DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED — METRIC

THE CITY OF CALGARY ROADS

Issue	Revision	Issue Date

STANDARD SYMBOLS FOR STREET LIGHTING DESIGN DRAWINGS

Date Approved By

For General Manager Calgary Roads

DES: CRC	SCALE:	DRAWING No.	SHEET
DWN: SSC	NOT TO SCALE	DS-BL	1

BLOCK	SYMBOL	DESCRIPTION
(CRPJB)	■ J	PROPOSED JUNCTION BOX
(CREJB)	□ J	EXISTING JUNCTION BOX
(CRRJB)	J	EXISTING JUNCTION BOX TO BE REMOVED
(CRPW)	\ | /	PROPOSED WALL MOUNT LUMINAIRE
(CREW)	\ | /	EXISTING WALL MOUNT LUMINAIRE
(CRDK)		STREET LIGHTING SERVICE CABINET
(CRSP)		STREET LIGHTING SERVICE PANEL
(CRPER)	PER	30AMP 1Ø 'PER' SERVICE UNIT
(CRCAP)		CONDUIT CAP
(CRPP)		UTILITY POWER POLE
(CRTP)		UTILITY TELEPHONE POLE
(CRPTP)		UTILITY POWER/TELEPHONE POLE
(CRPT)	T	UTILITY POWER TRANSFORMER
(NORTH)		NORTH ARROW

DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED METRIC

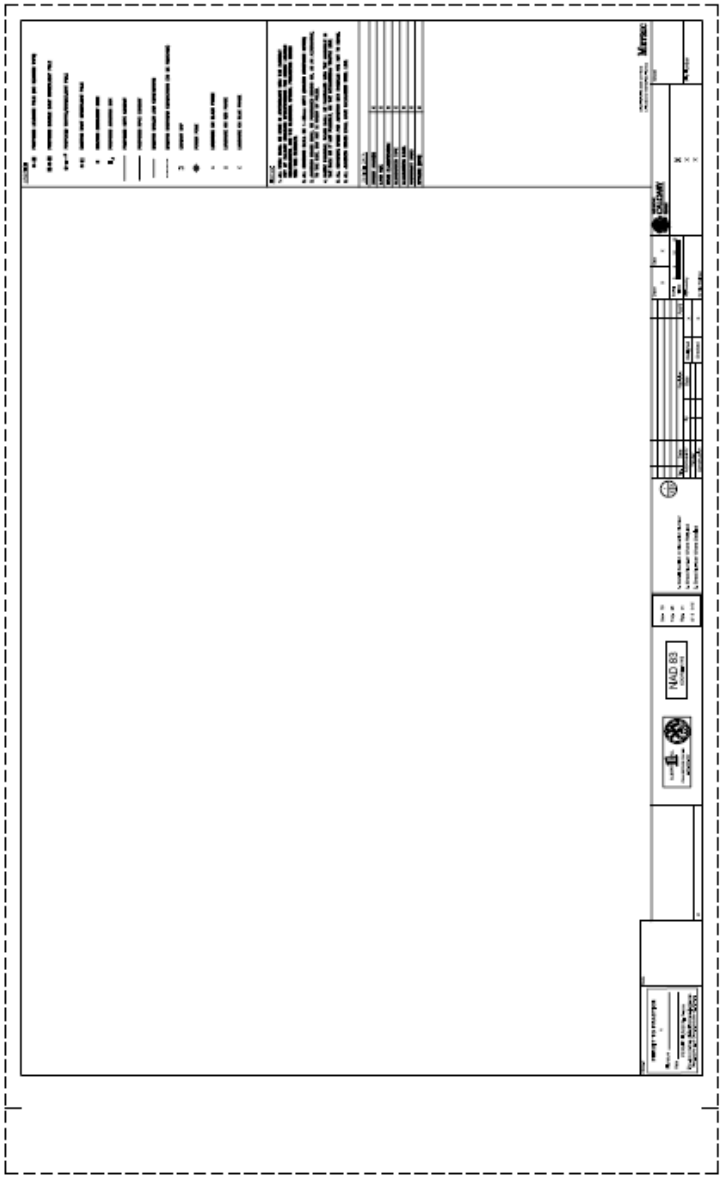
THE CITY OF CALGARY ROADS

Issue	Revision	Issue Date

STANDARD SYMBOLS FOR STREET LIGTHING DESIGN DRAWINGS

Date	Approved By	DES: CRC	SCALE:	DRAWING No.	SHEET
	For General Manager Calgary Roads	DWN: SSC	NOT TO SCALE	DL-BL	2


THE CITY OF CALGARY
LAND USE AND MOBILITY
CALGARY ROADS
CONTRACT FOR
STREET LIGHTING INSTALLATION
WHEREVER STREET N.E.
AVENUE 'A' TO AVENUE 'B'
TENDER No. XXXXX
BLOCK (COVSHT)
THE CITY OF CALGARY ROADS
METRIC
Issue
Revision
Issue Date
Date
Approved By
For General Manager Calgary Roads
STANDARD COVER SHEET FOR
STREET LIGHTING DESIGN DRAWINGS
DES: CRC
DWN: GJ
SCALE:
NOT TO SCALE
DRAWING No.
DL-BL
SHEET
3



BLOCK (CRSHT)

NOTE

1. DRAWING SCALE TO BE 1:500

DIMENSIONS ARE MILLIMETRES UNLESS OTHERWISE NOTED METRIC

THE CITY OF CALGARY ROADS

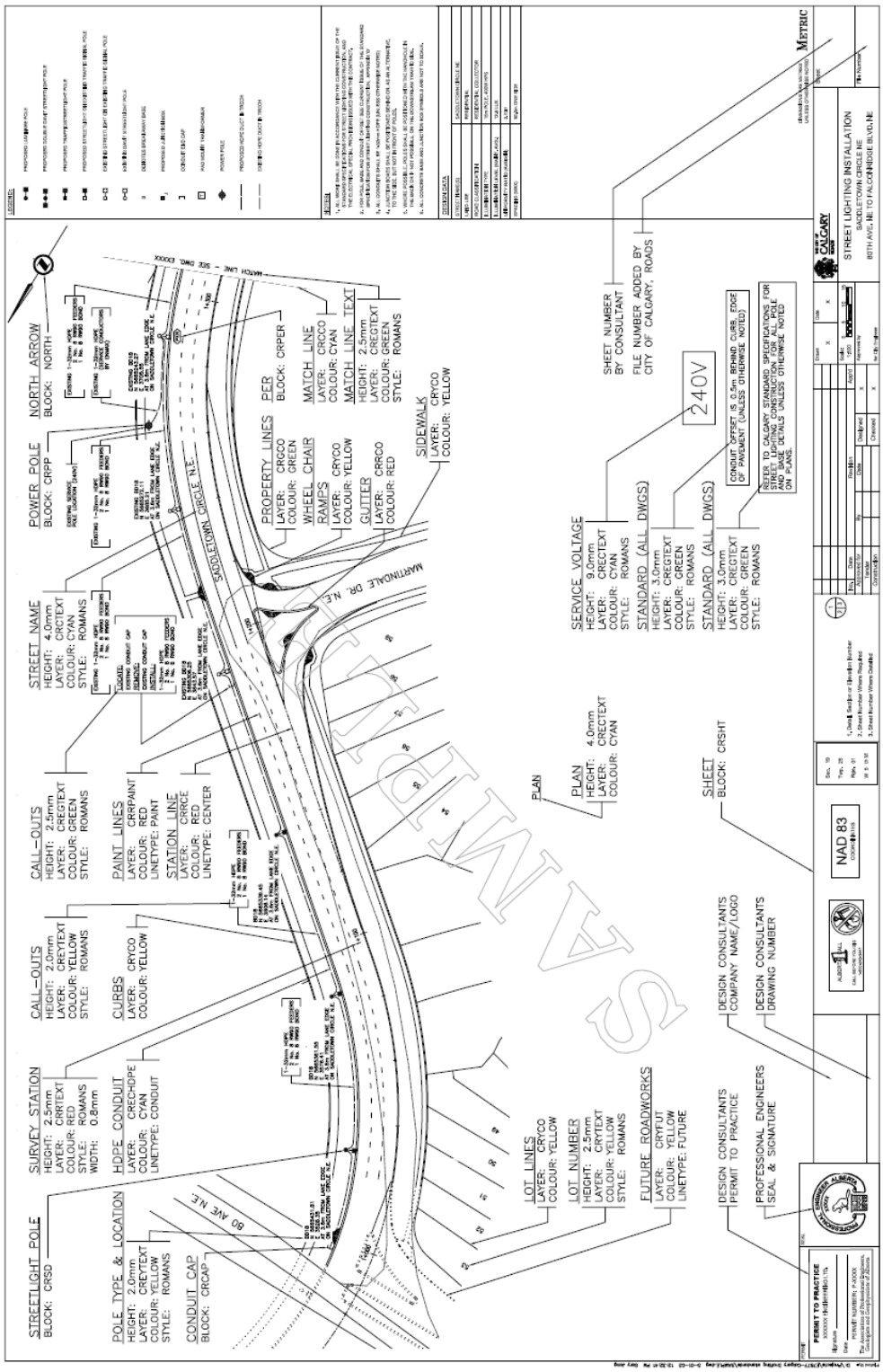
Issue	Revision	Issue Date

STANDARD DRAWING SHEET FOR STREET LIGHTING DESIGN DRAWINGS

Date Approved By

For General Manager Calgary Roads

DES: CRC	SCALE:	DRAWING No.	SHEET
DWN: SSC	NOT TO SCALE	DL-BL	4


SAMPLE
STREETLIGHT POLE
BLOCK: CRSD
SURVEY STATION
HEIGHT: 2.5mm
LAYER: CRRTEXT
COLOUR: RED
STYLE: ROMANS
WIDTH: 0.8mm
POLE TYPE & LOCATION
HEIGHT: 2.0mm
LAYER: CREYTEXT
COLOUR: YELLOW
STYLE: ROMANS
CONDUIT CAP
BLOCK: CRCAP
HDPE CONDUIT
LAYER: CRECHDPE
COLOUR: CYAN
LINETYPE: CONDUIT
CALL-OUTS
HEIGHT: 2.0mm
LAYER: CREYTEXT
COLOUR: YELLOW
STYLE: ROMANS
CURBS
LAYER: CRYCO
COLOUR: YELLOW
CALL-OUTS
HEIGHT: 2.5mm
LAYER: CREGTEXT
COLOUR: GREEN
STYLE: ROMANS
PAINT LINES
LAYER: CRRPAINT
COLOUR: RED
LINETYPE: PAINT
STATION LINE
LAYER: CRRCE
COLOUR: RED
LINETYPE: CENTER
STREET NAME
HEIGHT: 4.0mm
LAYER: CRCTEXT
COLOUR: CYAN
STYLE: ROMANS
POWER POLE
BLOCK: CRPP
NORTH ARROW
BLOCK: NORTH
PROPERTY LINES
LAYER: CRGCO
COLOUR: GREEN
PER
BLOCK: CRPER
WHEEL CHAIR RAMPS
LAYER: CRYCO
COLOUR: YELLOW
MATCH LINE
LAYER: CRCCO
COLOUR: CYAN
MATCH LINE TEXT
HEIGHT: 2.5mm
LAYER: CREGTEXT
COLOUR: GREEN
STYLE: ROMANS
GUTTER
LAYER: CRRCO
COLOUR: RED
SIDEWALK
LAYER: CRYCO
COLOUR: YELLOW
SADDLETOWN CIRCLE N.E.
MARTINDALE DR. N.E.
80 AVE N.E.
LOT LINES
LAYER: CRYCO
COLOUR: YELLOW
LOT NUMBER
HEIGHT: 2.5mm
LAYER: CRTTEXT
COLOUR: YELLOW
STYLE: ROMANS
FUTURE ROADWORKS
LAYER: CRYFUT
COLOUR: YELLOW
LINETYPE: FUTURE
PLAN
HEIGHT: 4.0mm
LAYER: CRECTEXT
COLOUR: CYAN
SERVICE VOLTAGE
HEIGHT: 9.0mm
LAYER: CRECTEXT
COLOUR: CYAN
STYLE: ROMANS
STANDARD (ALL DWGS)
HEIGHT: 3.0mm
LAYER: CREGTEXT
COLOUR: GREEN
STYLE: ROMANS
240V
STANDARD (ALL DWGS)
HEIGHT: 3.0mm
LAYER: CREGTEXT
COLOUR: GREEN
STYLE: ROMANS
CONDUIT OFFSET IS 0.5m BEHIND CURB, EDGE OF PAVEMENT (UNLESS OTHERWISE NOTED)
REFER TO CALGARY STANDARD SPECIFICATIONS FOR STREET LIGHTING CONSTRUCTION, DRILL HOLE AND BASE DETAILS UNLESS OTHERWISE NOTED ON PLANS.
SHEET NUMBER BY CONSULTANT
FILE NUMBER ADDED BY CITY OF CALGARY, ROADS
SHEET
BLOCK: CRSHT
DESIGN CONSULTANTS COMPANY NAME/LOGO
DESIGN CONSULTANTS DRAWING NUMBER
DESIGN CONSULTANTS PERMIT TO PRACTICE
PROFESSIONAL ENGINEERS SEAL & SIGNATURE
NAD 83
PERMIT TO PRACTICE
STREET LIGHTING INSTALLATION
SADDLETOWN CIRCLE NE
BOTH AVE. NE TO FALCONRIDGE BLVD. NE
METRIC

APPENDIX C: STREET LIGHTING DESIGN AND CONSTRUCTION PROCESS DIAGRAMS

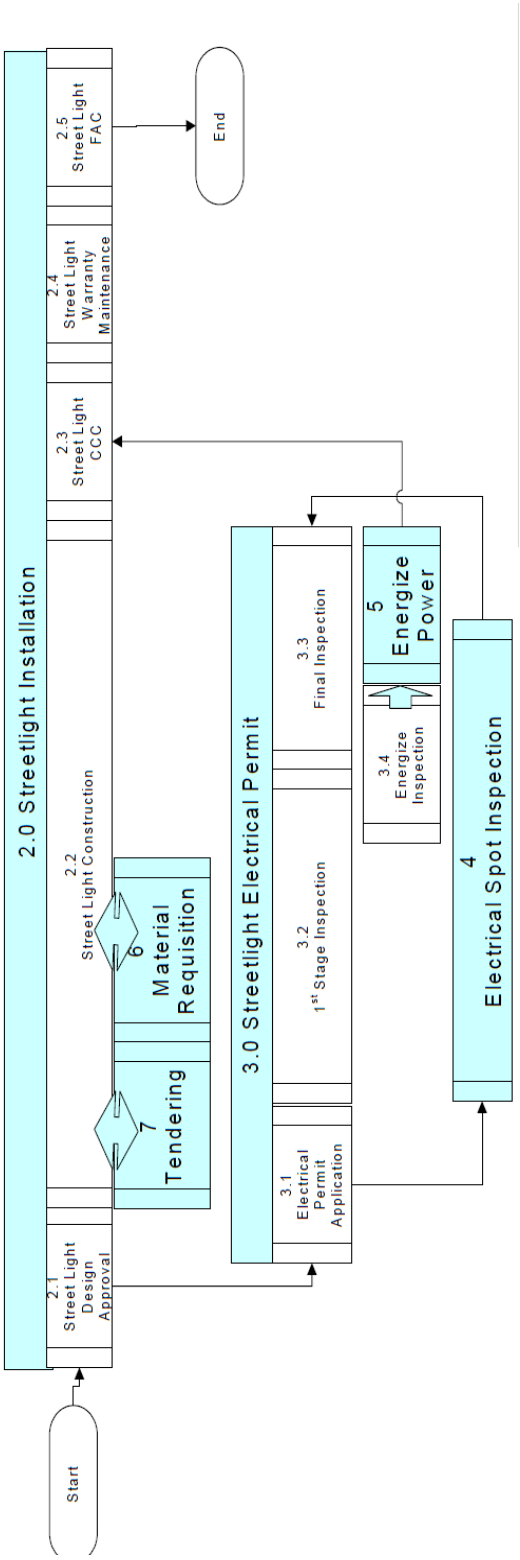


Figure 29: The City of Calgary Roads Business Unit Electrical Street Light Installation Project Process

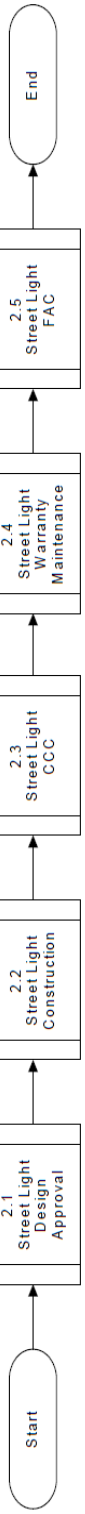


Figure 30: Asset Management Project Street Light Installation Process

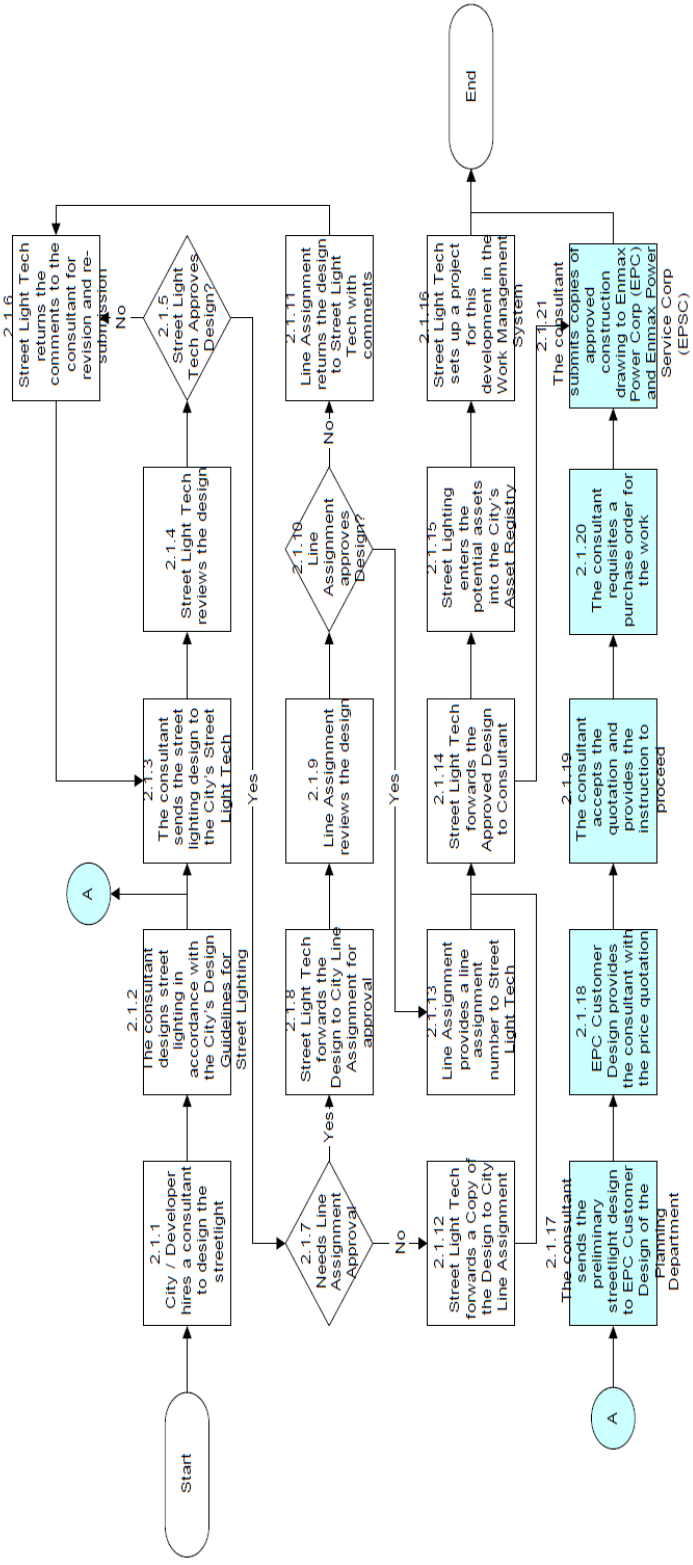


Figure 31: Street Light Approval

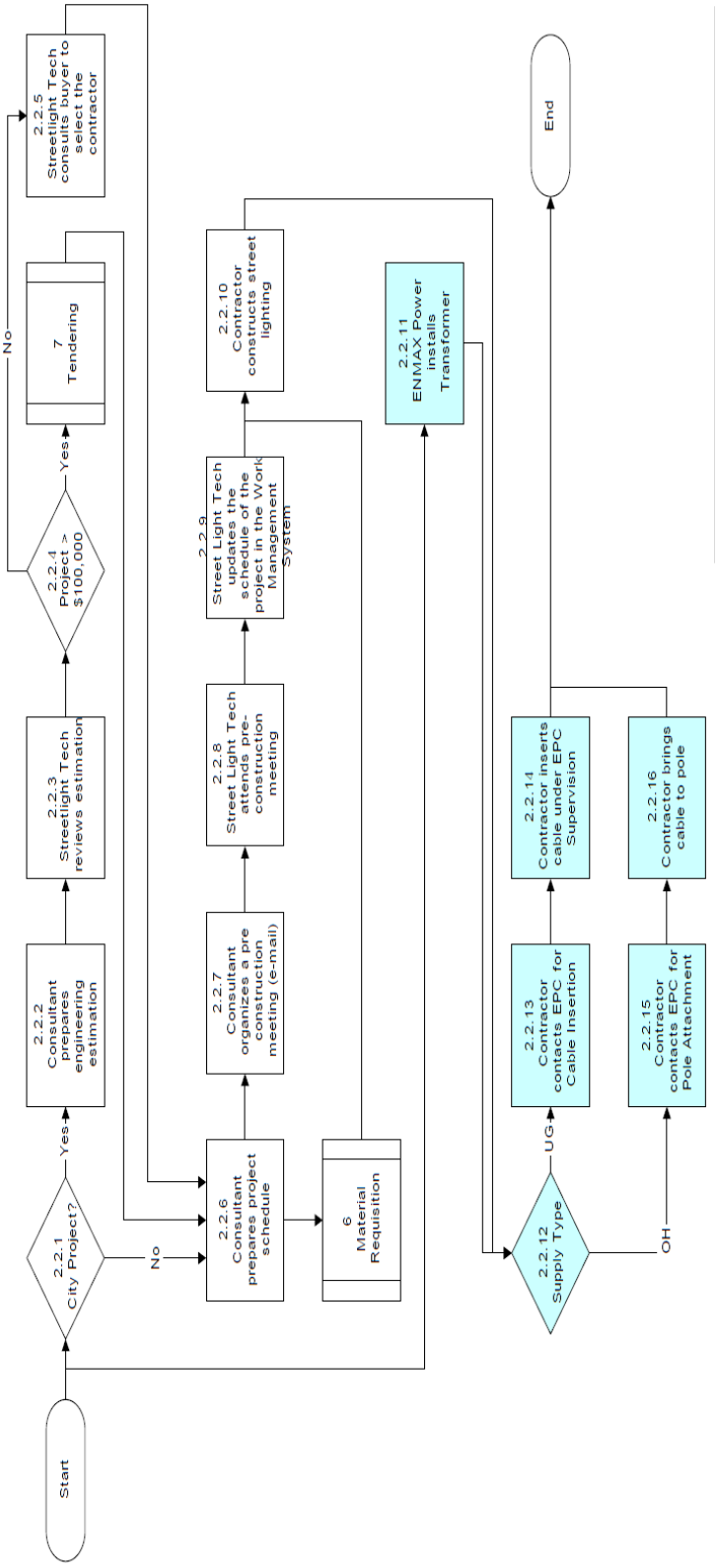


Figure 32: Street Light Construction

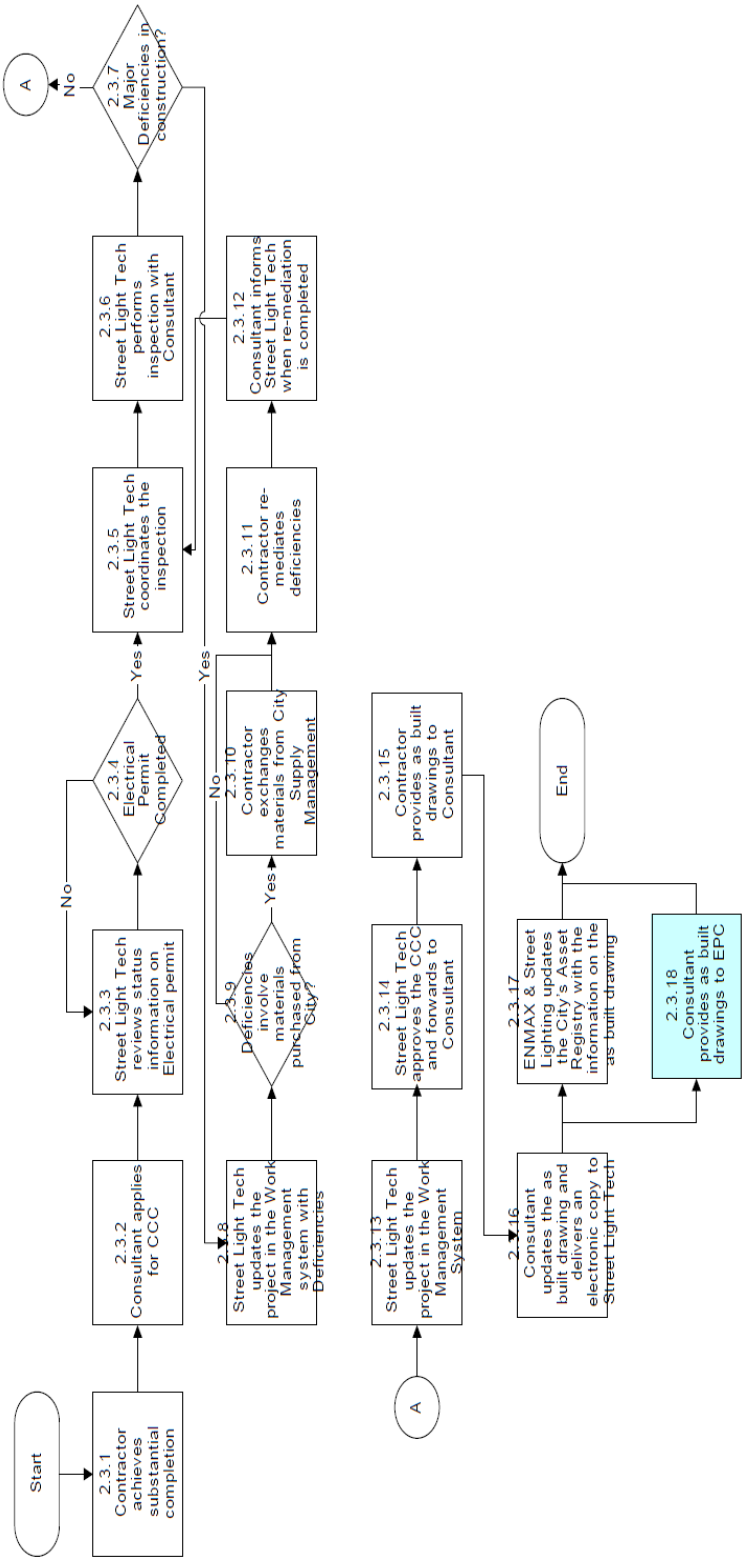


Figure 33: Street Light Construction Completion Certification (CCC)

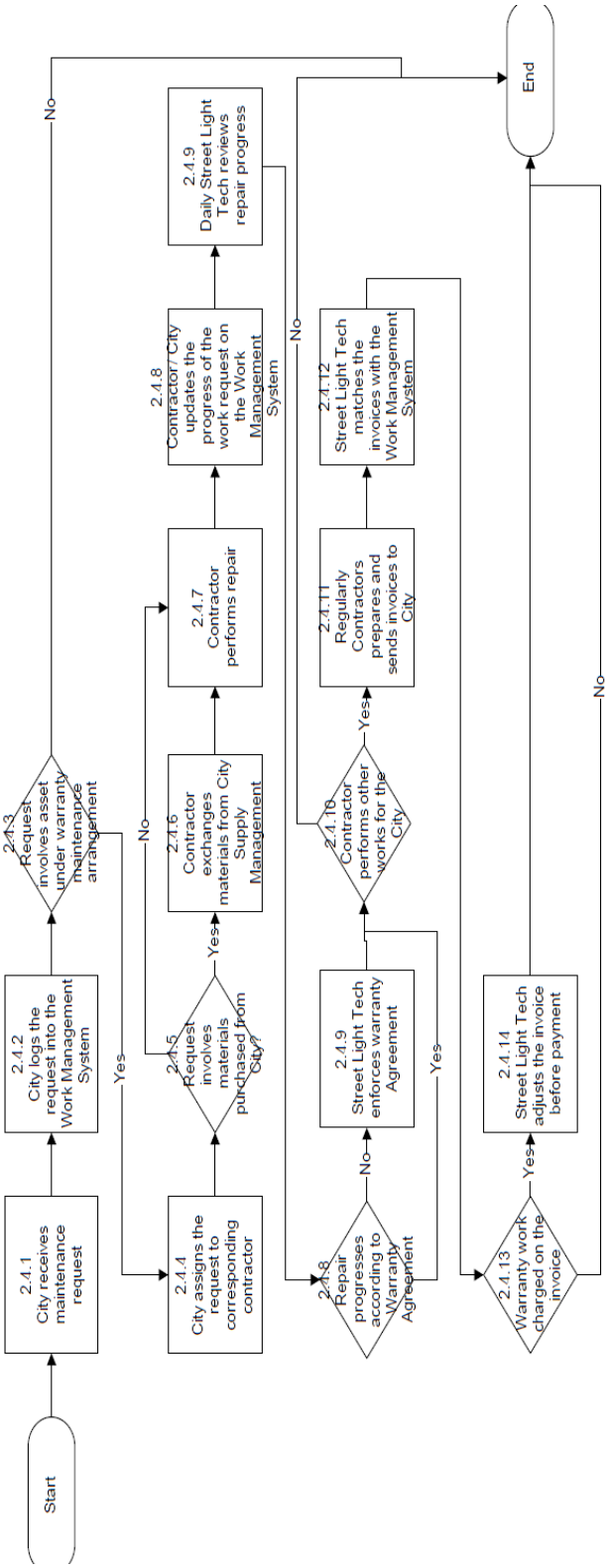


Figure 34: Street Light Warranty Maintenance

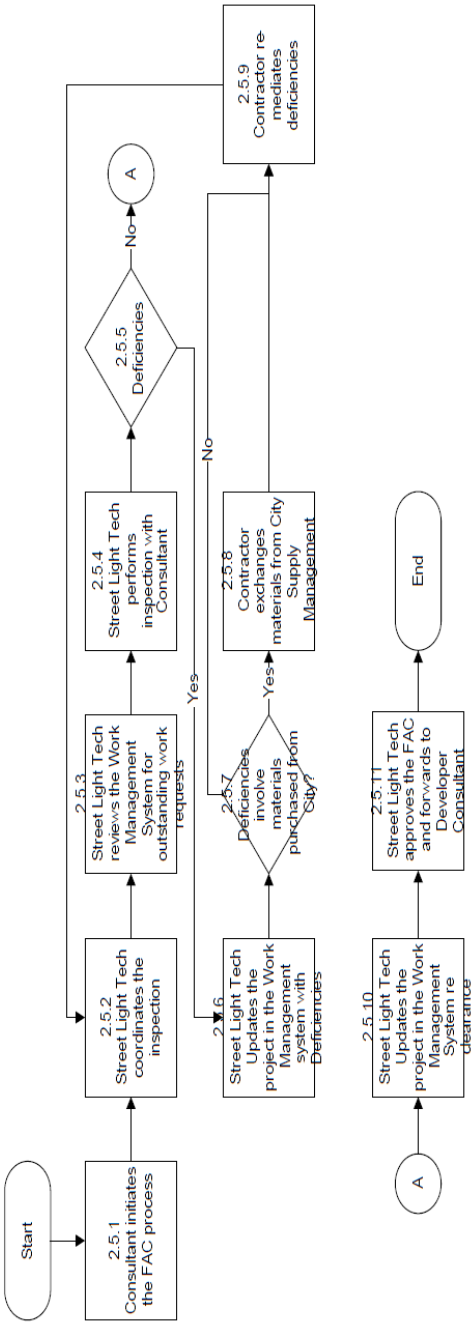


Figure 35: Street Light Final Acceptance Certificate (FAC)

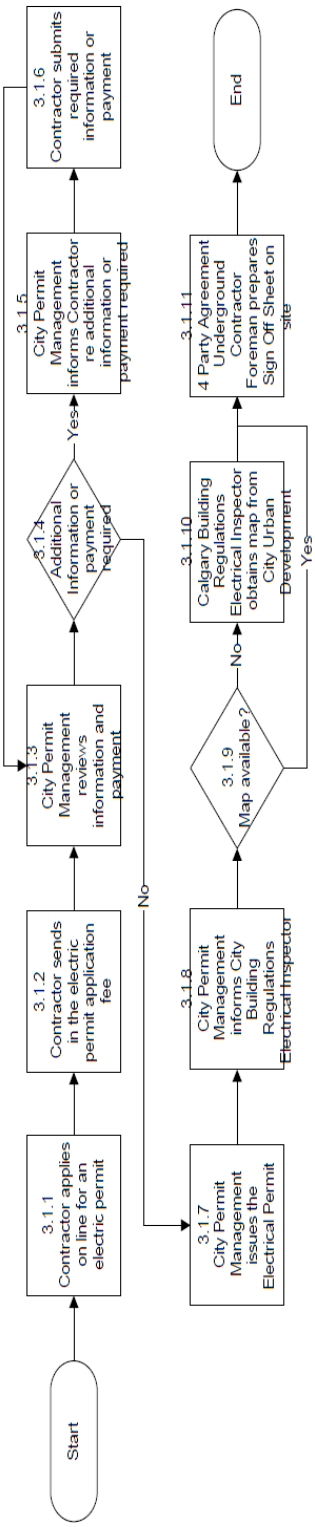


Figure 37: Electrical Permit Application

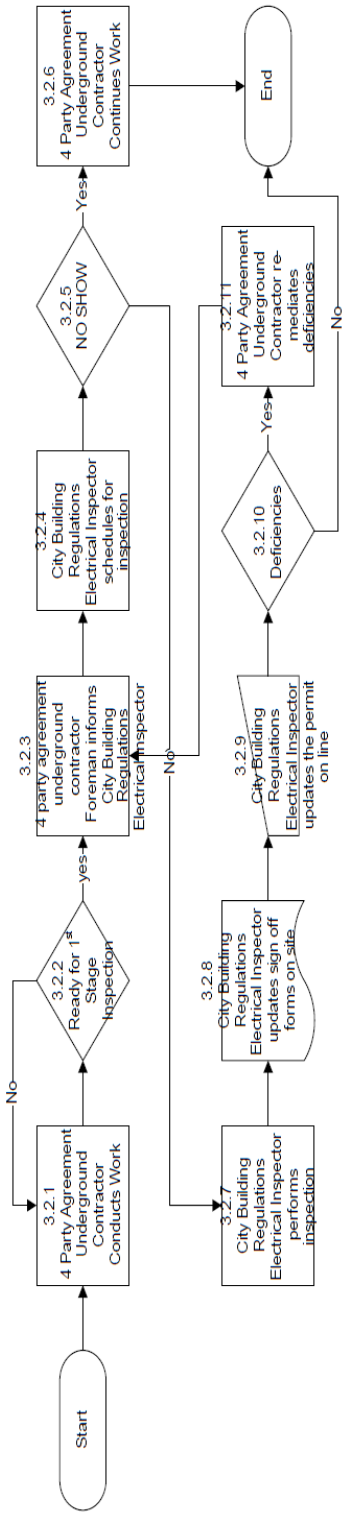


Figure 38: 1st Stage Inspection

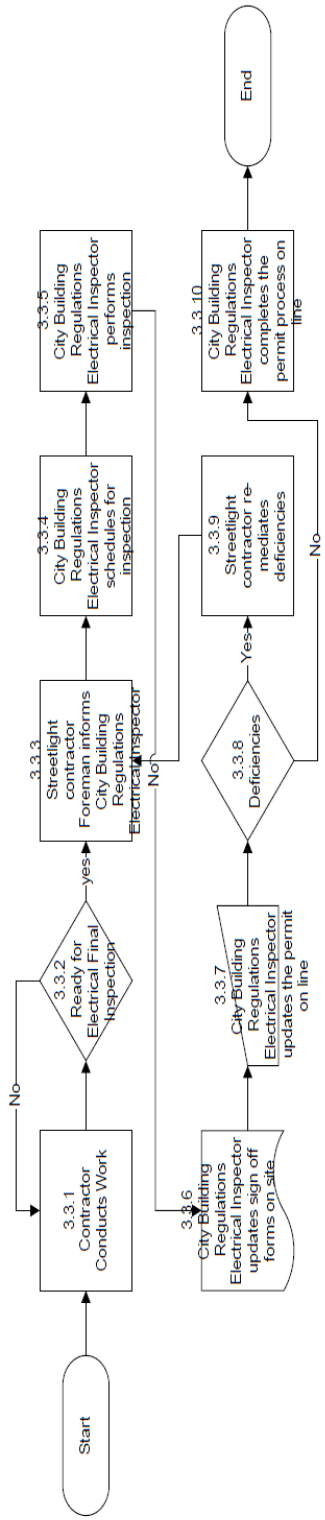


Figure 39: Electrical Final Inspection

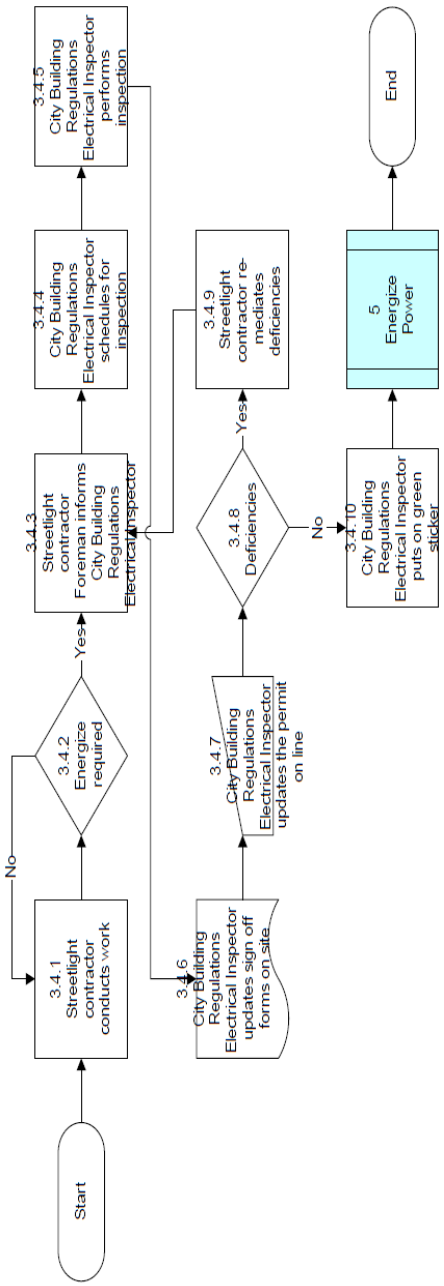


Figure 40: Energize Inspection

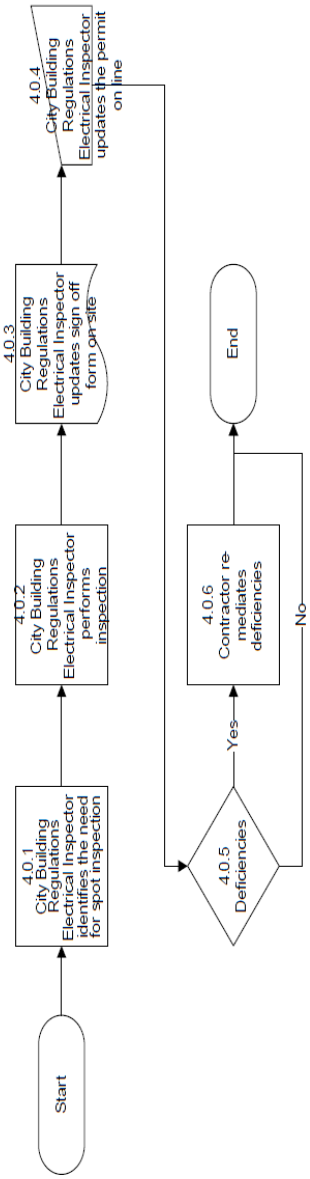


Figure 41: Electrical Spot Inspection

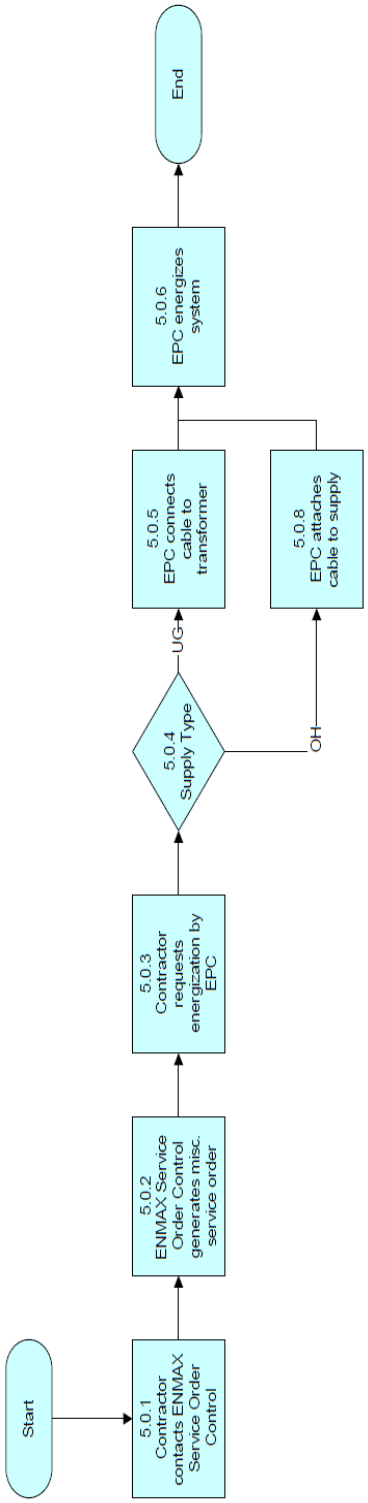


Figure 42: Energize Power

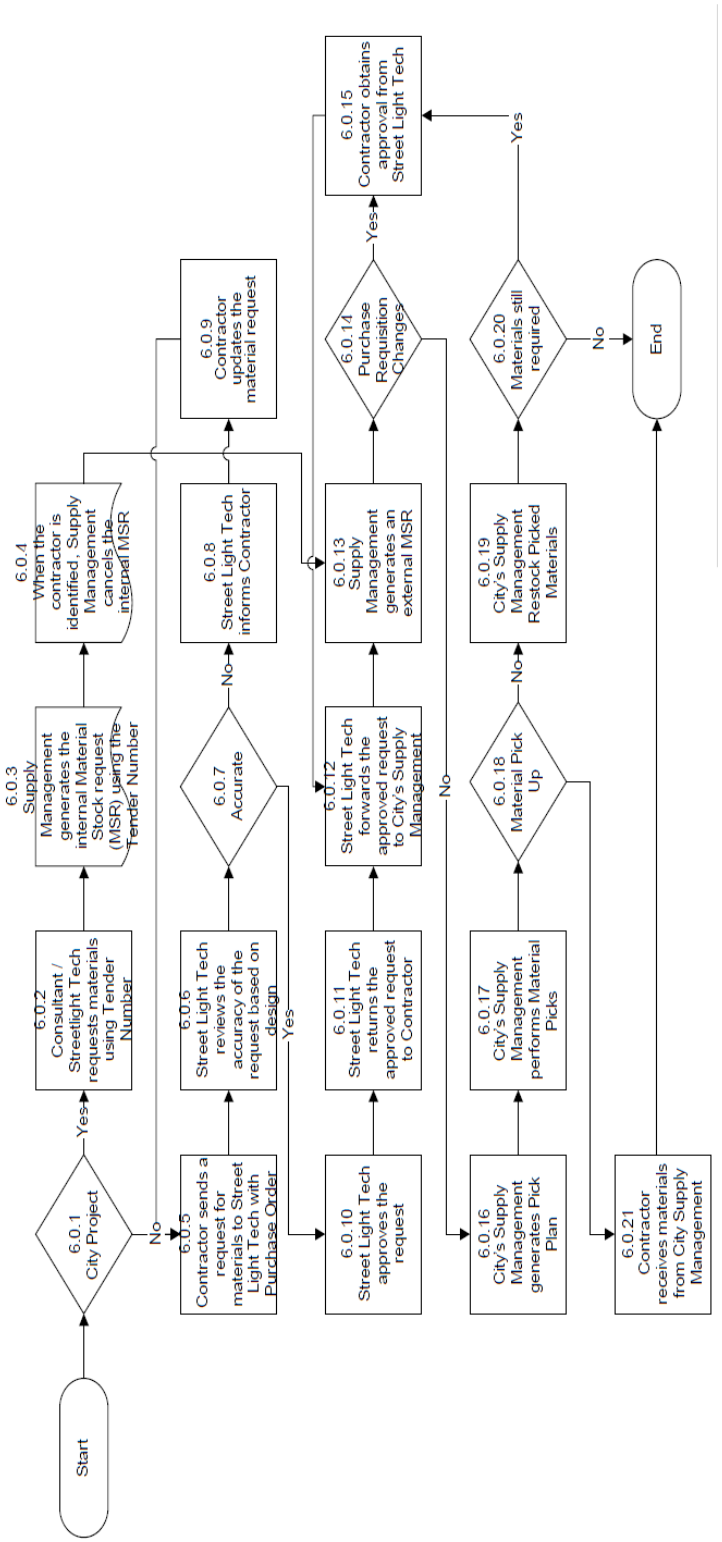


Figure 43: Material Requisition

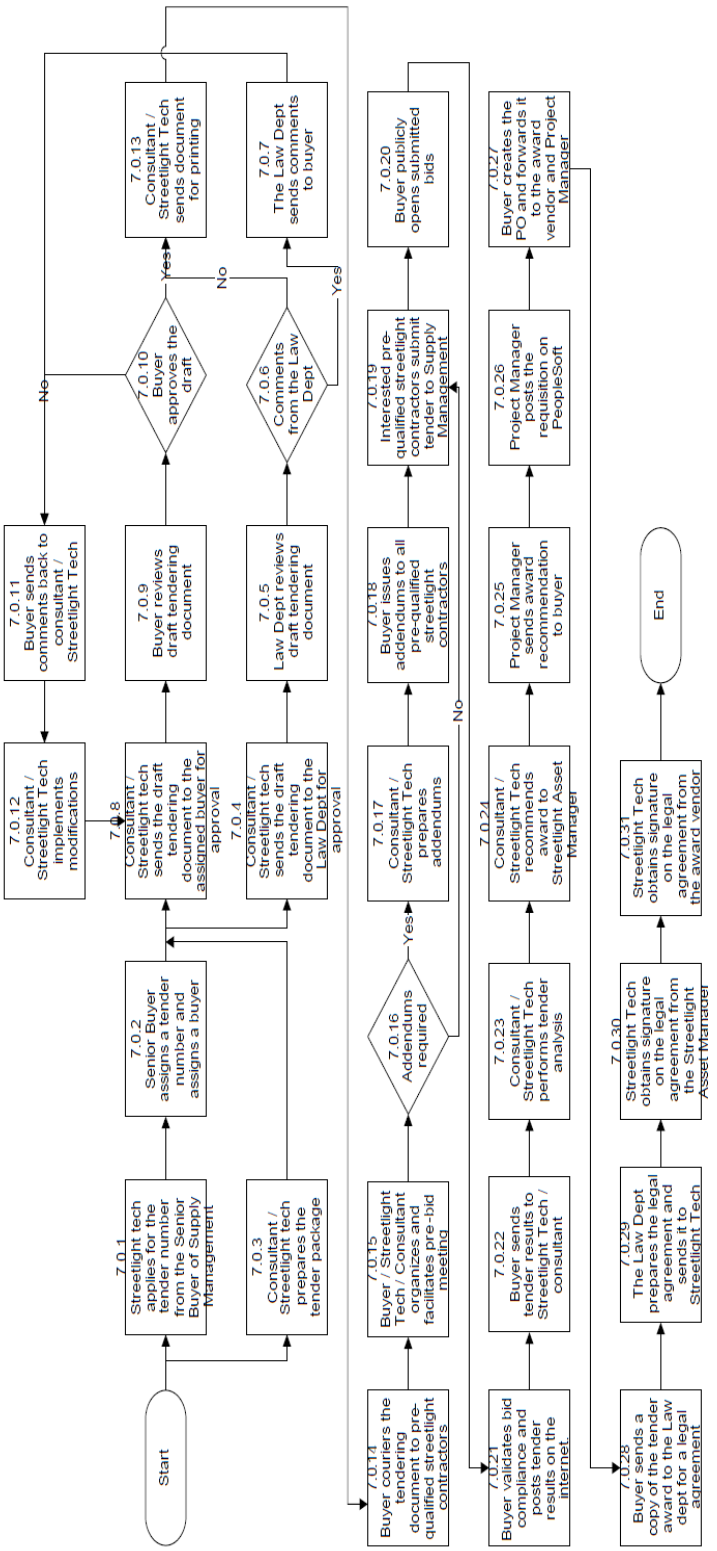


Figure 44: Tendering

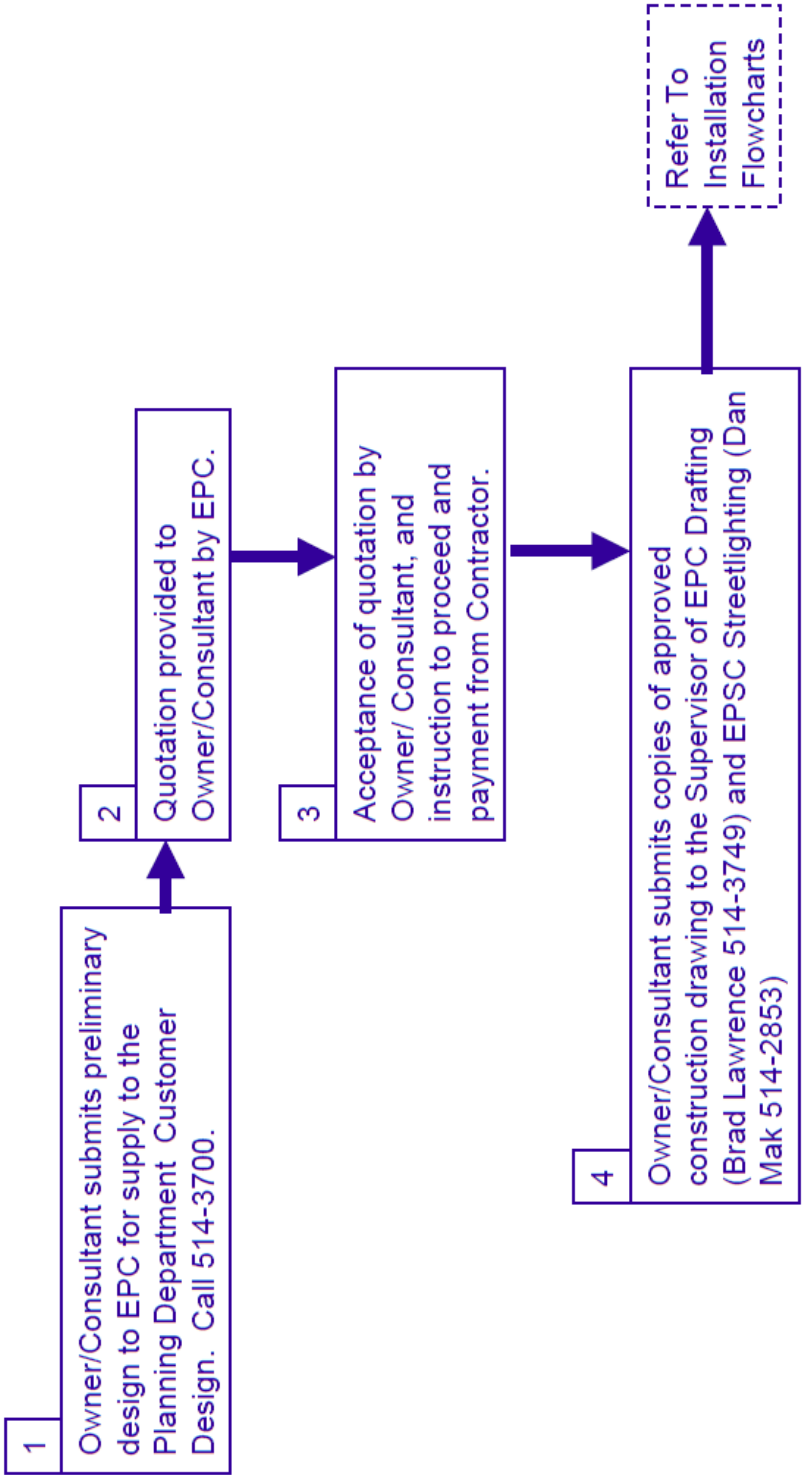


Figure 45: Street Light/ Traffic Power Installation Flowchart

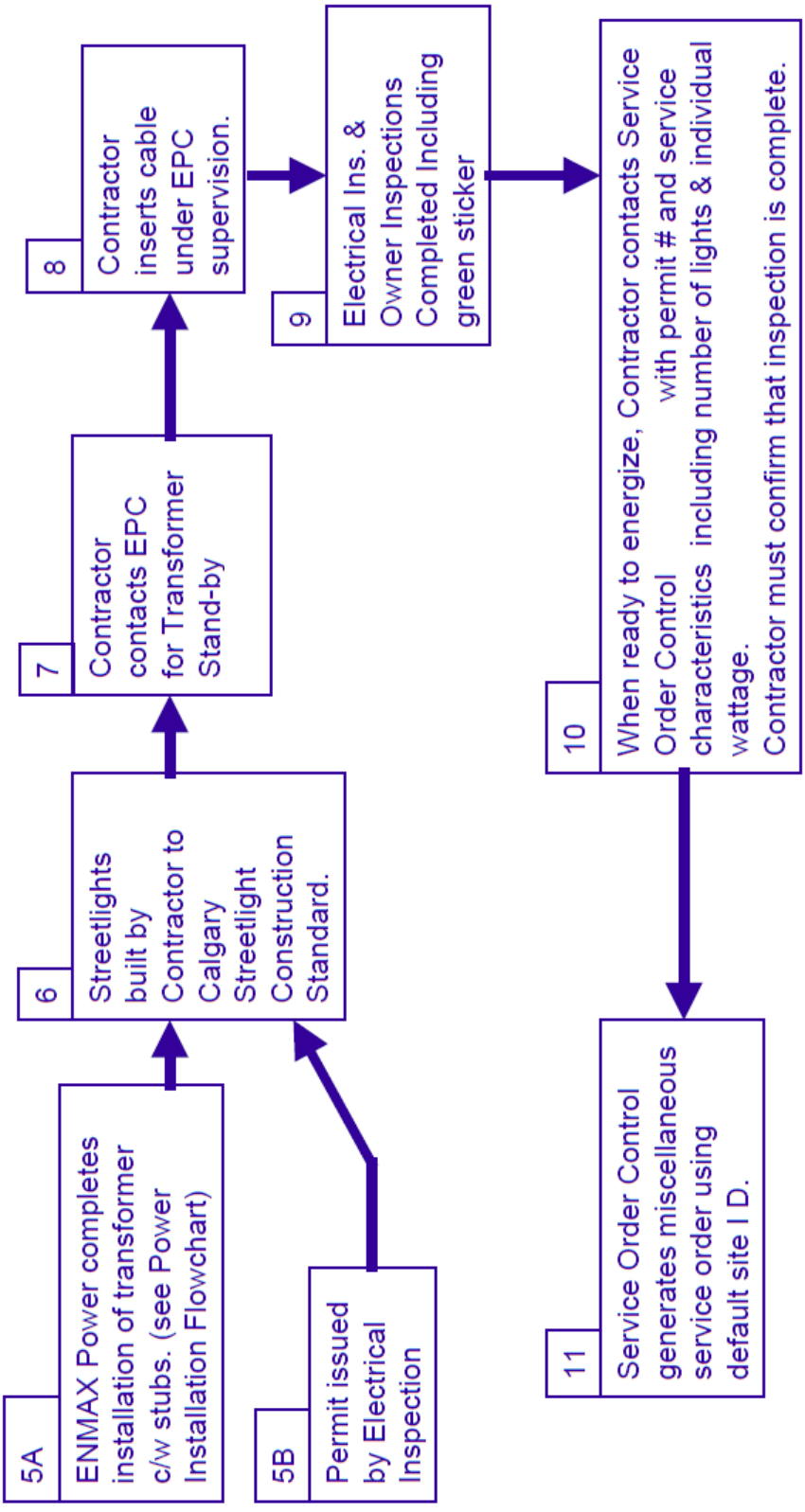


Figure 46: Street Light/ Traffic Installations - UG Supply

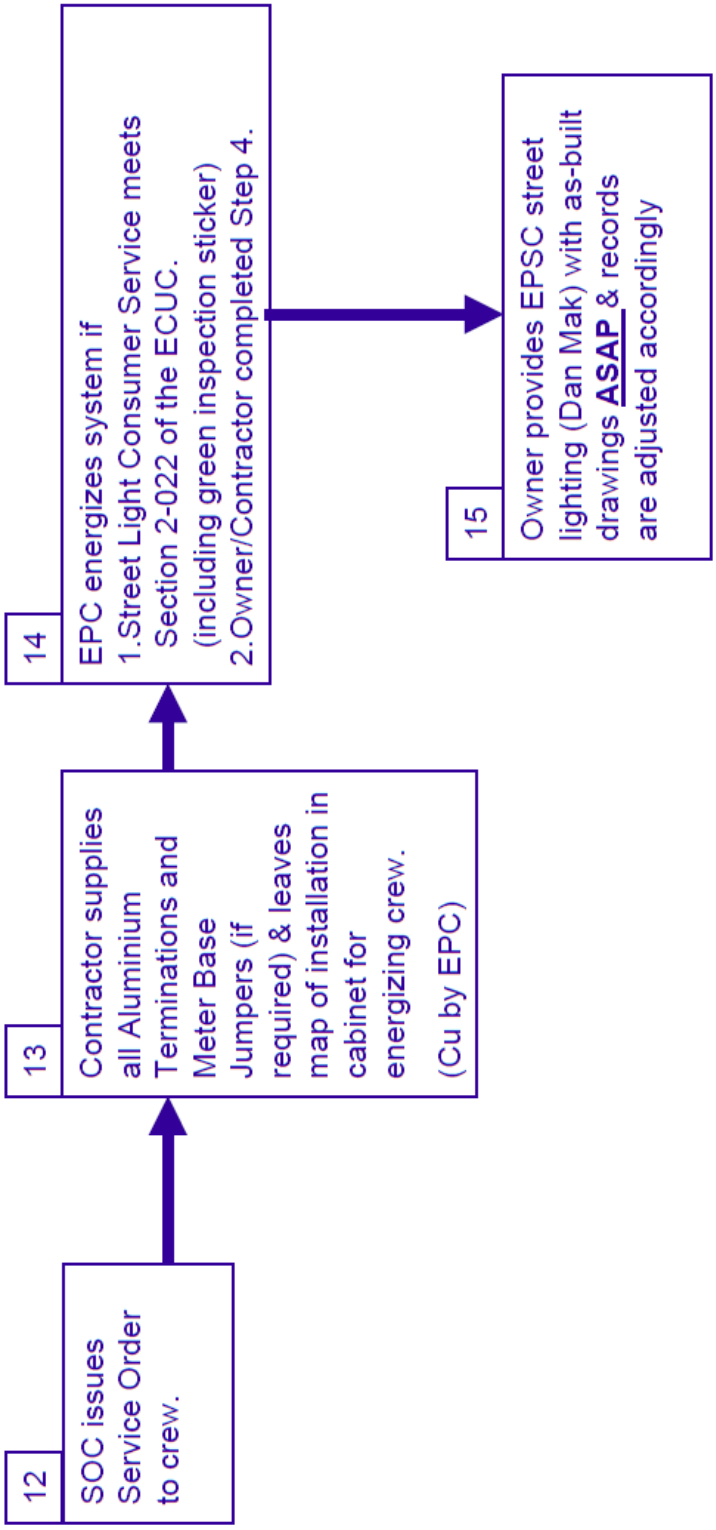


Figure 47: Street Light / Traffic Installation - UG Supply

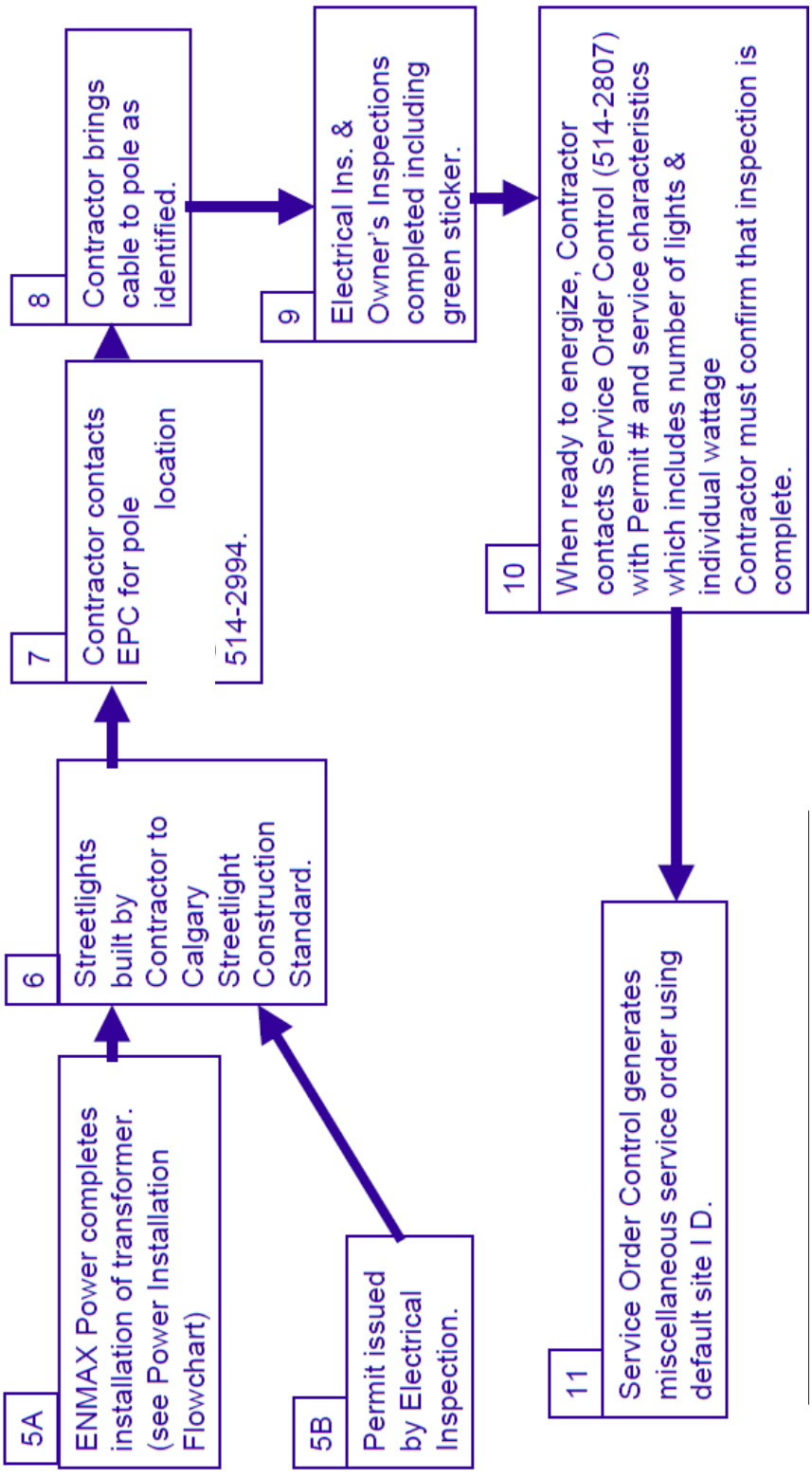


Figure 48: Street Light/ Traffic Installation - O/H Supply

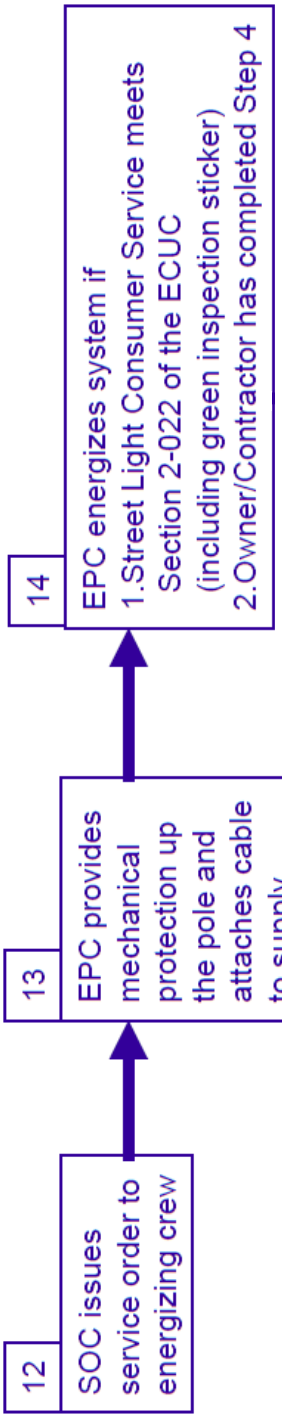


Figure 49: Street Light Installations - O/H Supply