

HIGHWAY

LIGHTING GUIDE

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FOREWORD

These guidelines are to be utilized for the design, placement, construction and maintenance of roadway lighting on provincial highways. Continuing comment is essential for regular updating of this guide and roadway lighting standards in general. Any feedback is welcomed and may be sent to Moh Lali, Director, Maintenance, Specifications and Traffic Engineering, Technical Standards Branch, Alberta Transportation, 4999 – 98 Avenue, Edmonton, Alberta, T6B 2X3.

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E1 INTRODUCTION

E1.1 Purpose

The purpose of this guide is to promote highway lighting design uniformity and enhance the safe and efficient operation of Alberta roads during dusk, dawn and night.

This guide establishes uniform roadway lighting design standards and procedures as they relate to the highway design functions of Alberta Transportation.

E1.2 Jurisdiction

These standards shall be used for all roadways under the control of Alberta Transportation, including those roads and highways passing through urban areas. Since many of the design charts and tables have been developed specifically for rural highways in Alberta, it is not recommended that municipalities use these guidelines.

Municipalities without their own roadway lighting guidelines are directed to the appropriate reference documents listed in E2.1 and it is recommended that they utilize the services of a qualified roadway lighting designer for their specific projects.

E1.3 Guide Format

The Alberta Transportation Highway Lighting Guide provides a tool for planners, designers and operators of the provincial highway system. The guide is comprised of eight main parts:

1. Introduction - An overview of purpose, jurisdiction, and format of the guide.
2. General Information - Identification of relevant reference documents and the roles and responsibilities of owners, designers, contractors, and suppliers.

3. Planning Guidelines - An overview of the planning principles in relation to a roadway lighting system, lighting warrants, and the interface with the provincial power providers.
4. Warrants - Methodology to assess the need for roadway lighting in a variety of circumstances.
5. Design Guidelines - Roadway lighting design procedures and considerations.
6. Lighting Components - Descriptions and performance criteria for the different components of a roadway lighting system.
7. Construction Guidelines - An overview of construction and commissioning procedures.
8. Maintenance Guidelines - An overview of roadway lighting maintenance procedures.

This guide has been organized in a 3-ring binder format to facilitate change and expansion. The date of issue is shown at the top of each page. The Highway Lighting Guide forms Volume "E" of the Traffic Control Standards for Alberta Transportation. The section and page number for the respective volume can be found at the bottom of each page.

Tables and figures have been inserted into the guide wherever possible. Technical drawings are provided at the end of each section and can be referenced by the appropriate drawing number contained within the text of the section.

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E2 GENERAL INFORMATION

E2.1 References

This Guide has been developed in accordance with the generally accepted engineering practices for roadway lighting and associated lighting systems. The Guide references many engineering standard practice documents, however, it also reflects current and historical practices in use by Alberta Transportation.

E2.1.1 Primary Reference Documents

The following documents and manuals form part of the technical requirements for the design of roadway lighting on roads under the jurisdiction of Alberta Transportation. In order to undertake a proper roadway lighting design, it is mandatory that all lighting designers have access to, and refer to, the latest release of the documents and manuals listed in Table 2.1:

TABLE 2.1 - PRIMARY REFERENCE DOCUMENTS

TOPIC	REFERENCE DOCUMENT(S)
Continuous Lighting Intersection Lighting Interchange Lighting	IESNA RP-8 American National Standard Practice for Roadway Lighting RTAC/ARTC Guide for the Design of Roadway Lighting TAC Illumination of Isolated Rural Intersections
Tunnels	IESNA RP-22 American National Standard Practice for Tunnel Lighting
Walkways and Bikeways	IESNA DG-5 Recommended Lighting for Walkways and Class 1 Bikeways
Signs	IESNA RP-19 Recommended Practice for Roadway Sign Lighting
Rest Areas	IESNA CP-38 Lighting Roadway Safety Rest Areas
Weigh Scales / Vehicle Inspection Areas	IESNA CP-38 Lighting Roadway Safety Rest Areas IESNA RP-20 Recommended Practice for Lighting for Parking Facilities
Roadways near Airports	IESNA RP-17 Recommended Practice for Airport Road Automobile Parking Area Lighting
At-Grade Railway Crossings	Transport Canada Road/Railway - Grade Crossing Manual

E2.1.2 Auxiliary Reference Documents

The documents and manuals in Table 2.2 may be referred to for additional reference information pertaining to the design and

construction of lighting systems on Alberta Highways. When appropriate, lighting designers shall make reference to the latest release of these auxiliary documents for additional guidance.

TABLE 2.2 - AUXILIARY REFERENCE DOCUMENTS

TOPIC	REFERENCE DOCUMENT (S)
Continuous Lighting Intersection Lighting Interchange Lighting	IESNA RP-33 Recommended Practice on Lighting for Exterior Environments IESNA LM-69 Interpretation of Roadway Luminaire Photometric Reports IESNA LM-50 Photometric Measurements of Roadway Lighting Installations
Tunnels	IESNA LM-71 Photometric Measurement of Tunnel Lighting Installations
Rest Areas, Weigh Scales, Vehicle Inspection Areas	IESNA LM-64 Photometric Measurements of Parking Areas
Signs	IESNA LM-52 Photometric Measurements of Roadway Sign Installations
Light Trespass	IESNA TM-11 Light Trespass: Research, Results and Recommendations IESNA TM-10 Addressing Obtrusive Light in Conjunction with Roadway Lighting
General Alberta Transportation Procedures and Standards	Alberta Transportation, Engineering Consultant Guidelines for Highway and Bridge Projects. Alberta Transportation, Highway Lighting, Standard Specifications for Highway Construction. Alberta Transportation, Traffic Accommodation in Work Zones. Alberta Transportation, Utility Guidelines
Lighting Maintenance	IESNA DG-4 Design Guide for Roadway Lighting Maintenance

E2.1.3 Conflicting Recommendations

When specific requirements are provided in this Guide, they shall be taken as most current and relevant. Should the requirements and recommendations from the Primary Reference Documents listed in Table 2.1 conflict, the document with the most recent publishing date shall be taken as the most current and the most appropriate for use in roadway lighting designs.

E2.2 Glossary of Definitions, Acronyms, Symbols and Abbreviations

Lighting designers shall insure that they have a clear and accurate understanding of the definitions, acronyms, symbols and abbreviations used in this Guide so that there is no misunderstanding when the technical requirements are defined.

A listing of the definitions, acronyms, symbols and abbreviations used within is provided in the Glossary of Definitions, Acronyms, Symbols and Abbreviations at the back of this Guide.

E2.3 Qualification Process

E2.3.1 General

All Consultants, Contractors and Suppliers must be pre-qualified to perform any work, or supply any material and equipment for Alberta Transportation lighting projects.

E2.3.2 Consultants

General provisions for the qualifications of consultants are outlined in Alberta Transportation's *Engineering Consultant Guidelines for Highway and Bridge Projects*. All interested Consultants must be pre-qualified

to be eligible to design roadway lighting systems.

In addition to the requirements stipulated in Alberta Transportation's *Engineering Consultant Guidelines for Highway and Bridge Projects*, interested Consultants may be requested to submit the following with their application for pre-qualification:

- List of current designs including references (names and phone numbers) relating to roadway lighting;
- Provide evidence of full understanding of the Alberta Transportation Highway Lighting Guide, TAC, and IESNA RP-8 Guidelines for Roadway Lighting;
- List of key roadway lighting personnel complete with related past and present duties and résumés;

Failure to submit the information requested above may result in disqualification in the pre-qualification process.

The Consultant may be disqualified for any just reason including the following:

- Repeated failure of the Consultant to fully comply with requirements of this Guide or Alberta Transportation requirements for roadway lighting;
- Repeated problems with design practices or procedures;
- Repeated failure to complete assignments within the agreed upon time;
- Failure to supply appropriate back-up information to verify any design or layout as outlined in the Guide;
- Failure to maintain up-to-date, state-of-the-art, design practices and procedures.

E2.3.3 Contractors

The general provisions for the qualification of contractors are outlined in Section 1.2.5 of the *Standard Specifications for Highway*

Construction. All Contractors must be pre-qualified to be eligible to install and/or perform maintenance work on roadway lighting systems.

E2.3.4 Suppliers

Alberta Transportation maintains an approved products list for the following categories of roadway lighting equipment:

- Pole Bases
- Poles
- Luminaires
- Equipment Enclosures.

Appendix A, Highway Lighting Products List Categories summarizes categories for which Alberta Transportation will consider listing highway lighting products.

Material to be supplied by contractors for either construction or maintenance purposes should be included on the Alberta Transportation Products List. This list can be accessed from the Alberta Transportation web site:

<http://www.trans.gov.ab.ca/Content/doctype253/production/mts104.htm>

Information on how to have a product included in the Products List can be obtained from the Alberta Transportation Web site at:

<http://www.trans.gov.ab.ca/Content/doctype253/production/mts101.htm>

E3 PLANNING GUIDELINES

E3.1 Alberta Transportation Lighting Systems

Alberta Transportation has developed a functional classification system that categorizes Alberta's highway network. This system serves as a technical tool for planning and programming roadway improvements and assists in the development of rational engineering standards used to ensure safe, efficient and economical travel.

The Alberta Transportation Highway Geometric Design Guide provides a detailed description of Alberta Transportation's Roadway Functional Classification System and Roadway Design Designations. From a lighting perspective, it can be assumed that the functional classification and design designation of the highway have already been determined based on traffic volume, access, and abutting land development factors. The need and design of roadway lighting shall be a function of the highway's classification and should not act to influence its design designation.

The Provincial Highway System is comprised of major and minor highways in both urban and rural settings. The determination of "major" and "minor" is primarily based on Average Annual Daily Traffic (AADT) volumes. The need for and design of roadway lighting can be significantly different under these two conditions. Urban conditions introduce many factors such as pedestrians, roadside obstacles, narrower rights-of-way, and ambient lighting not experienced in rural environments. In rural areas factors such as transition lighting, pole setbacks, and maintenance factors may have a greater design influence.

E3.1.1 Area Class

Urban roadway lighting applies to conditions where a provincial highway passes through a city, town, village or hamlet. The roadway is typically characterized by having an 'urban' design cross-section. With the exception of freeways and expressways, this generally includes a vertical curb, sidewalk, sub-surface storm drainage, and typically a lower design and operating speed.

Urban roadway lighting design typically involves reduced pole setbacks, shorter lighting poles, closer spacing, and a greater consideration of pedestrians and adjacent land uses.

Suburban roadway lighting refers to conditions similar to urban conditions from the aspect of roadway design section and adjacent development. The difference under suburban conditions is that the distance to adjacent development is generally greater and the density of development is lower than in urban conditions. Suburban conditions also include developed areas that may be somewhat remote from other adjacent urban or suburban areas while continuing to be part of a larger urban or metropolitan planning area. Pedestrians are a consideration but not to the same extent as in urban conditions.

Roadway lighting design requirements for suburban areas generally fall in between those defined for urban and rural settings

Rural roadway lighting refers to conditions with wider available rights-of-way, and flat pavement edges with ditches to provide for surface drainage. Traffic volumes may vary considerably depending on the roadway's functional class and location. Pedestrians are generally not an issue in rural settings. The availability of a nearby convenient power source may be an issue in a rural environment.

E3.1.2 Roadway Class

Freeway means a multi-lane divided highway having a minimum of two lanes of traffic in each direction and full control of access and egress.

Expressway means a multi-lane divided highway having a minimum of two lanes of traffic for each direction. Access is limited, mostly through interchanges. Some at-grade intersections may exist. Generally this is an interim stage for divided highways being upgraded to freeway.

Arterial means a highway primarily intended for through traffic, usually on a continuous route. Direct access to abutting land may be restricted or eliminated.

Collector means a highway facility that provides for traffic movements between arterials and local streets, with some direct access to adjacent property.

Local means a street or road primarily for access to residences, businesses or other abutting property.

E3.2 Wire Service Providers and Energy Retailers

Alberta Transportation's jurisdiction extends to all highways within the province of Alberta. Within that area there are several electric utility "wire service providers" (WSP) and various energy retailers.

The lighting designer shall apply to the local WSP to obtain the site's physical power services (wires and transformer). This process is outlined in Section E5.7.

E3.3 Scope of Lighting

The lighting designer must clearly understand the extent of the lighting that should be proposed for a particular project. The general scope of the project is usually included within

the project terms of reference. The lighting designer should become familiar with the nature of the project by reviewing the lighting design limits and the previous lighting warrants undertaken. Any adjustments to the lighting design limits must be documented in the pre-design report (See Section E5.1.1.)

E3.4 Principles of Planning

The planning of a roadway lighting system involves the consideration of a number of aspects. These aspects include a review of safety, capital and operating costs, existing inventories, logistical constraints, light trespass, light pollution, and aesthetics. The decision to provide a lighting system will necessitate tradeoffs among all these aspects and it will be the responsibility of the lighting designer to recommend the best system.

E3.4.1 Safety

The primary objective of roadway lighting is to enhance vehicle safety by providing drivers with improved nighttime visibility of roadway conditions and potential hazards.

While roadway lighting may improve the visibility of objects at night, it may also create the condition where the driver's vision must adjust back to darkness when leaving the lighted area. For this and budgetary considerations, the decision to provide roadway lighting must be based on a documented need and the application of appropriate warrant criteria.

Since roadway lighting is installed as an aid to safety, lighting poles must also be installed in safe locations that recognize their potential hazard to vehicles. Their location must also consider the ability of crews to conduct maintenance in a safe and effective manner.

E3.4.2 Energy Conservation

Energy costs add up to a sizeable portion of

the life cycle cost analysis for a proposed project. In achieving an optimal lighting design while minimizing costs, the lighting designer is required to provide life cycle cost evaluations of at least two, and optimally three proposed lighting systems in the pre-design report. The life cycle cost will evaluate the lighting proposal in relation to capital costs and long-term operating and maintenance costs.

E3.4.3 Efficiency

The efficiency of a roadway lighting system is dependant on the balance of several factors including pole height, pole locations, luminaire wattage and resultant overall project life cycle costs. In general, a roadway section warranting lighting shall be designed to use the least amount of lighting infrastructure. Fewer poles enhance safety and aesthetics and reduce capital and maintenance. The lighting designer shall meet the minimum lighting requirements of this guide but, in the case of continuous lighting without conflict areas, shall avoid exceeding the minimum requirements by more than 10% whenever possible.

E3.4.4 Aesthetics

Roadway lighting aesthetics is influenced in the most part by the pole height and layout. Lighting designers are encouraged to initiate their designs with the critical pole placements in the typical layouts described in Chapter E5. Closely spaced intersections that feature different pole configurations usually lead to a less than pleasing aesthetic design.

For urban conditions, roadside development should be considered when selecting mounting heights.

Special aesthetic considerations may need to be considered in certain urban environments such as through the centre of downtown or other improvement districts. In all such cases,

the roadway lighting standards contained in this guide must be adhered to. Modifications to the pole or luminaire design from an aesthetic perspective must receive separate approval. The local municipality shall be responsible for any incremental capital or operational costs incurred as a result of the specialized lighting design.

E3.4.5 Environmental Concerns

Some highway locations pose various environmental factors that should be considered when designing roadway lighting. These include:

Wildlife. Where lighting is installed in an area with a significant wildlife concern, consideration should be given to lighting areas past the roadway edge. This will assist in the identification of the wildlife entering the roadway and aid the motorist in avoiding a collision. This is particularly beneficial on highways with minimal right-of-way tree clearing. The use of approved taller davits with a larger set back from the roadway will facilitate a wider lit area.

Landscaping. In some locations, usually through urban centres, there may be existing or proposed landscaping with tall trees along the roadside. When designing lighting in these areas, the lighting designer shall work with the landscape designer to find the best locations for all light poles with respect to the trees. The spacing from centre of trees to poles is dependant on the mature tree canopy height and width. Generally, a minimum centre-to-centre distance of 5 m should be kept from light pole to a coniferous tree and up to 10 m for deciduous trees such as the common poplar or aspen. If the interference from landscaping is significant, median lighting can be considered. If the trees interfere with an adjacent walkway parallel to the roadway, then separate walkway lighting can be considered.

E3.4.6 Use of Standard Lighting Applications

Standard pole placements as shown in Chapter E5 shall be used as a guide for general placement prior to initiating a more detailed roadway lighting design. Use of the standard pole placements is limited to determining critical pole placements such as the closest location of a light pole with respect to an off-ramp "gore" point. Once the critical pole placements are set, further poles may be added where necessary to obtain the required light levels.

E3.4.7 Lamp Types

All new lighting designs shall utilize High Pressure Sodium (HPS) lamps. The majority of existing roadway lighting lamp types fall into three basic categories:

High Pressure Sodium (HPS) is the most common lamp employed for roadway lighting. Long lamp life, high efficacies, universal mounting positions and robust construction make this lamp an excellent choice for roadway lighting.

Low Pressure Sodium (LPS) lamps are classified as being monochromatic (one colour) and reserved for areas where colour rendering is not a factor. Low Pressure Sodium lamps have been employed in remote rural intersections, in tunnel lighting and for decorative or special effects roadway lighting. Existing LPS roadway lighting installations will be phased out as they reach the end of their design life. Any project involving modifications or extensions to lighting at LPS locations should include a life cycle cost analysis to convert the balance of the system to HPS lamps.

Metal Halide (MH) lamps offer much higher efficacy than mercury vapor lamps and better light quality than either mercury or sodium lamps, however, they take up to six minutes to start and up to twenty minutes to restart

after each power outage. Operating costs for Metal Halide lamps are typically higher than for sodium lamp types. Metal Halide lamps are used for sign lighting or other situations where colour rendition is of high importance.

E3.4.8 Unintentional Lighting

Obtrusive light, sometimes referred to as "light pollution", is a common concern of the general public. Obtrusive light not only detracts from the enjoyment of the nighttime 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 increased energy efficiency of the lighting design.

Obtrusive light 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

Sky Glow is the result of stray light being scattered in the atmosphere, resulting in added "sky brightness".

Glare, which can be described as unwanted source luminance, is defined by the Illumination Engineering Society of North America (IESNA) 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".

IESNA RP-8, Annex C, contains a more detailed definition of glare, glare assessment methods and glare reduction methods.

Refer to "Luminaire Cutoff Classification" (Section E6.2.5.6), which describes standards

on addressing light trespass, light pollution and glare with cutoff style luminaries.

Roadway lighting systems shall be designed to minimize light pollution by applying the recommendations in the following IESNA technical documents:

- IESNA TM-10
- IESNA TM-11
- IESNA RP-8, Annex C

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, lighting designs shall be designed to minimize light pollution as outlined in IESNA RP-33.

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E4 WARRANTS

Prior to starting any roadway lighting design, the extent of the required lighting, whether continuous, full, partial or delineation, must be determined.

All highway construction projects shall include a lighting needs assessment or warrant analysis. The warrant analysis shall be reviewed and accepted by Alberta Transportation prior to commencing the detailed lighting design.

Situations may occur where lighting is warranted but cannot be installed due to conditions or circumstances (i.e. not economically feasible, physical obstruction by other services, etc.).

Alberta Transportation maintains a roadway lighting priority list. All locations that warrant roadway lighting are placed on this list and the installation of lighting is based on annual capital budget availability.

E4.1 Definitions

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

Full Lighting refers to lighting covering an 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 roads between sub-intersections within the interchange area.

Partial Lighting refers to the lighting of key decision areas, potential conflict points, and/or conflict areas (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 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.

E4.2 Situations Warranting Lighting

Sections E4.2.1 to E4.2.12 describe situations where roadway lighting will be considered as being warranted. Lighting in all other situations will be considered unwarranted and, if required or requested by a project, will be subject to the jurisdictional and cost sharing rules as defined in Table 4.1. It should be noted that all unwarranted lighting must still meet all the design requirements of these guidelines.

E4.2.1 Continuous Lighting

It is important that the lighting designer understand that the Roadway Classifications used in this guide may be used and defined differently by other documents, zoning bylaws, and agencies. When selecting a roadway classification, the area of roadway should best fit the descriptions contained in Table 5.2.

Warrants for Continuous Lighting on roadways, between intersections and interchanges, shall be determined using the TAC Guide for the Design of Roadway Lighting. This entails the application of TAC Section 2.4.2 and Table 2.4.2.2, and the use of the applicable warrants assessment sheets for the specific section of roadway as illustrated in the TAC Guide:

TAC Table 2.4.2.1a - Warrants for non-controlled access roadways.

TAC Table 2.4.2.1b - Warrants for controlled access roadways.

TAC Table 2.4.2.1c - Warrants for partially controlled access roadways.

While the warrant procedures appear to be relatively straightforward, this approach

should not be so rigid that “engineering judgment” is not considered.

TABLE 4.1 - ROADWAY LIGHTING RESPONSIBILITIES

	Installation Cost	Operations and Maintenance	Life Cycle Replacement or Upgrading	Ownership
TRANS Systems	TRANS	TRANS	TRANS	TRANS
Municipal Systems Lighting Warranted	TRANS ^{1,2}	M ³	TRANS	TRANS ⁴
Municipal Systems Sentry Lighting Warranted	TRANS	M	TRANS	TRANS ⁵
Municipal Lighting Not Warranted	M ⁵	M	M	TRANS ⁵
All Existing Municipal Systems “Non-Invested”	N/A	M	U	U ⁶
<p>TRANS Alberta Transportation M Municipality U Utility</p> <p>1 Except where developer/municipality/industrial development initiates the need to install or modify a system</p> <p>2 TRANS will pay the installation costs provided that the program funding is available</p> <p>3 The department was paying for operating costs of some municipal systems installed on major highways before cost sharing was implemented</p> <p>4 TRANS should own the facility since it is within our right-of-way</p> <p>TRANS ownership will prohibit the possibility for anyone to make changes or modifications without our prior knowledge</p> <p>TRANS ownership will ensure that existing cost sharing agreements remain in place and cannot be shut-off once installed</p> <p>5 Municipality will be permitted to install a system only if the installation meets department requirements and standards</p> <p>6 Possible buy-down by TRANS in future if ownership or control by TRANS is desired.</p>				

E4.2.2 Intersections

For the purposes of this guide, intersections are defined as *Rural Intersections*, *Suburban Intersections* or *Urban Intersections*. Also included in the category of Intersections are *Isolated Traffic Conflict Areas*. Notwithstanding the above definitions, lighting is always required at signalized intersections.

E4.2.2.1 Rural Intersections

Lighting warrants for *Rural Intersections* shall be determined by application of the TAC

Illumination of Isolated Rural Intersections manual. This will result in a requirement for full lighting, partial lighting, delineation lighting or no lighting.

E4.2.2.2 Suburban Intersections

Lighting warrants for *Suburban Intersections* shall be determined by application of the TAC Illumination of Isolated Rural Intersections manual. This will result in a requirement for full lighting, partial lighting, delineation lighting or no lighting.

E4.2.2.3 Urban Intersections

Full lighting is always warranted at *Urban Intersections*.

E4.2.3 Isolated Traffic Conflict Areas

An *Isolated Traffic Conflict Area* is an area on a roadway without a lighting system, or separated from a lighting system by twenty seconds or more of driving time, where an increased potential exists for collisions between vehicles, between vehicles and pedestrians, or between vehicles and fixed objects.

It should be noted that the recommendations relating to lighting warrants for these areas in the TAC Guide for the Design of Roadway Lighting manual state that lighting “should be considered” when certain conditions apply. The following is a list of such areas with the associated warrant requirements.

E4.2.3.1 Midblock Crosswalks

Lighting warrants for *Midblock Crosswalks* shall be determined by the application of TAC Guide for the Design of Roadway Lighting, Section 2.4.3.6.

E4.2.3.2 Exit Areas

Lighting warrants for Exit Areas shall be determined by the application of TAC Guide for the Design of Roadway Lighting, Section 2.4.3.3.

E4.2.3.3 Merge Areas

Lighting warrants for Merge Areas shall be determined by the application of TAC Guide for the Design of Roadway Lighting, Section 2.4.3.4.

E4.2.3.4 Railway Crossings

Lighting warrants for *Railway Crossings* shall be determined by the application of TAC

Guide for the Design of Roadway Lighting, Section 2.4.3.5.

E4.2.3.5 Hazardous Locations

Lighting warrants for *Hazardous Locations* shall be determined by the application of TAC Guide for the Design of Roadway Lighting, Section 2.4.3.7.

E4.2.4 Interchanges

Interchanges are actually a collection of some or all of the following:

Exit ramps;

Entrance ramps;

Acceleration lanes;

Deceleration lanes;

Intersections;

Straight or curved sections of roadway.

In order to determine whether full, partial or no lighting is required, it is necessary, among other things, to give the appropriate weighting to the location of the interchange.

E4.2.4.1 Urban Interchanges

Full lighting is always warranted at *Urban Interchanges*.

E4.2.4.2 Suburban Interchanges

Lighting warrants for *Suburban Interchanges* shall be determined by the application of the TAC Guide for the Design of Roadway Lighting Table 2.4.2.1d - Warrants for Interchange Lighting. The warrant score dictates the requirement for either full or partial lighting.

E4.2.4.3 Rural Interchanges

Lighting warrants for *Rural Interchanges* shall be determined by the application of the TAC Guide for the Design of Roadway Lighting

Table 2.4.2.1d - Warrants for Interchange Lighting. The warrant score dictates the requirement for either partial or no lighting.

E4.2.5 Bridges and Overpasses

Bridges, if designed with appropriate barriers, parapets, and shoulders, are no different than the normal roadway. Theoretically, bridges do not require any special lighting. However, public perception of roadways on bridges as being less safe than at-grade roadways can cause traffic flow to deteriorate along typically long bridges, particularly over water. As such, warrants are detailed below to aid traffic flow on bridges.

The roadways that travel across overpasses are included in the definition of bridges.

E4.2.5.1 Roadways on Bridges

Lighting warrants for Roadways on Bridges shall be determined by application of TAC Guide for the Design of Roadway Lighting Section 2.4.2.3. Either of the two conditions stated in TAC will trigger the warrant.

E4.2.5.2 Marine Navigation Lights on Bridges and Bridge Piers

The need for navigation lights on Alberta Transportation bridges is not common. However, some locations may meet the criteria for these lights as determined by the Federal Government. Designers shall confirm the need and requirements for Marine Navigation Lights or Bridge Pier Lights on Bridges over navigable waterways with Alberta Transportation.

E4.2.6 Tunnels and Underpasses

The purpose of general roadway lighting in tunnels is to provide for daytime and nighttime vision. However, the primary purpose of tunnel lighting is to provide proper internal pavement and wall luminance

to counteract the affects of entering a dark restricted area during the daytime.

Tunnels and Underpasses are both defined as structures covering a roadway. To differentiate between tunnels and underpasses, the definitions in IESNA RP-22, Section 2.2.1 - Tunnels, Section 2.2.3 - Underpasses and Table 1 must be applied.

E4.2.6.1 Tunnels

Lighting warrants for daytime and nighttime lighting in tunnels shall be determined by the application of IESNA RP-22 Section 2.2.1 and Table 2.

E4.2.6.2 Underpasses

Lighting warrants for nighttime lighting in Underpasses shall be determined by the application of IESNA RP-22 Section 2.2.3 and Table 2. Daytime lighting is not required for underpasses.

E4.2.7 Signs

This guide only addresses the requirements for lighting on the following sign types:

Regulatory and Warning Signs;

Guide and Information Signs;

Special Facility Signs (weigh scales, rest areas, etc.).

Tourist Attraction and other similar signs are not addressed in this guide. Regardless, these are typically shoulder-mounted signs, and by default would not require lighting.

E4.2.7.1 Shoulder Mounted Signs

Lighting is not required on shoulder or ground-mounted signs.

E4.2.7.2 Overhead Signs

Sign lighting is only considered for large overhead signs, such as signs mounted on

cantilever structures, sign bridges, or overpasses. Lighting is not required on small overhead signs such as lane use and turning restriction signs.

Lighting is not required on large overhead signs, provided the signs are fabricated from super-high-intensity retro-reflective sheeting (or better), and that the signs are located with adequate retro-reflectivity sight distance (approximately 300 m).

If an overhead mounted sign, fabricated from super-high-intensity retro-reflective sheeting, is located at such a viewing angle that the retro-reflectivity is inadequate at a sight distance of 300 m, then sign lighting should be considered. The designer must determine from the technical specifications of the retro-reflective material whether or not the viewing angle of the sign is greater than that allowable for proper retro-reflection. In special cases there exists the ability to waive these requirements, the most common being unavailability of power in the area.

E4.2.8 Rest Areas

This guide addresses the lighting requirements for three types of rest areas associated with the Alberta Transportation roadway system. When determining lighting warrants, consideration must be given to physical size and layout, location (close to urban areas or remote), the types of vehicles using the rest area and the hours of operation (daylight only or 24-hour). Roadway safety is the first priority at entrances and exits, while personal safety is the first priority within the facility itself.

E4.2.8.1 Class I - Major Rest Areas

Lighting is always required for Class I - Major Rest Areas and entry and exit lanes to and from the rest area.

E4.2.8.2 Class II and III - Smaller Rest Areas

Lighting in Class II - Smaller Rest Areas shall be required when the following applies:

- The Rest Area is open for nighttime use, and;
- Electrical power is available at or near the Rest Area site.
- When Alberta Transportation requests Rest Area lighting.

The need for entry and exit lighting shall be determined based on the warrants for intersections, consistent with the land use of the area. Entry and exit lighting should not be provided unless the rest area itself is illuminated.

Lighting for Class III Rest Areas (turnouts), including the entries and exits, shall be required only when specifically directed by Alberta Transportation.

E4.2.9 Vehicle Inspection Stations

This guide addresses the lighting requirements for the three types of Vehicle Inspection Stations. By the nature of the functions performed at these locations (as defined in the Alberta Transportation Highway Geometric Design Guide, chapter F.1), it is assumed that all Vehicle Inspection Stations will have electrical power available. The possibility of 24-hour use with some level of pedestrian traffic is also assumed.

Lighting for Class A, Class B and Class C Vehicle Inspection Stations is always required. Vehicle Inspection Station area entry and exit lighting is also always required.

E4.2.10 Roadways Under CCTV Surveillance

All roads under surveillance by Closed Circuit Television (CCTV) cameras will require special CCTV lighting considerations if the

CCTV surveillance is intended to extend into the nighttime hours.

Continuous roadway lighting will be required in areas of nighttime CCTV surveillance, such as freeway traffic management systems.

Partial CCTV lighting will be required in areas of localized surveillance, such as Web cameras installed to monitor specific locations along highways. The partial lighting shall extend for the field of view of the camera; including the multiple viewing areas if pan, tilt, and zoom camera technology is employed.

Roadways meeting the warrant for CCTV level lighting require lighting to the design criteria for continuous lighting outlined in Section E5.4.1. Lighting is not required to

roadway lighting design criteria requirements, unless the roadway lighting warrants are met.

E4.2.11 Construction Detours

Lighting requirements for Construction Detours shall be determined using the Alberta Transportation Guide for Traffic Accommodation in Work Zones.

E4.2.12 Other Situations

There may be other situations, within a project, where lighting is warranted on a special basis. Lighting designers shall confirm the need for lighting these special situations with Alberta Transportation.

E5 DESIGN GUIDELINES

E5.1 Alberta Transportation Procedures

The roadway lighting design process is summarized in the flowchart and checklists provided as Appendix B.

E5.1.1 Pre-Design Report

A Pre-Design report is required for all highway lighting design projects. There is no specific format for the pre-design report, however it shall address the following basic issues as well as any others, specific or requested in the project terms of reference.

- Summary of previous lighting warrant analysis including a review of the most current lighting warrant to confirm the lighting requirements based on current conditions.
- Documentation of any existing roadway lighting infrastructure and lighting levels.
- Assessment of design options available to comply with the lighting requirements of this Guide. The design options shall be of sufficient detail to produce a comparative life cycle cost estimate. Refer to the "Life Cycle Cost Evaluation" process described in Appendix C. Advantages and disadvantages of each option addressing issues such as public safety, economics, maintenance, standards and aesthetics shall be listed.
- A discussion of any expected concerns related to power supply, compatibility with adjacent lighting systems or land use, urban centres, airports or railway crossings.
- A preliminary design drawing of the recommended option.
- A Light Calculation Table.

E5.1.2 Project Categories

Roadway lighting design projects will typically fall into one of two categories:

Multi-discipline: Where the lighting design is a component of a larger more comprehensive highway design project. In these cases, the lighting design forms a part of an overall larger set of design drawings and tender package.

Stand Alone: The lighting design comprises all or the majority of the design.

The lighting designer must consider contractibility in preparing the roadway lighting design. When lighting is being installed in combination with other road works, the lighting designer shall consider the phasing of roadway and other utility construction. The lighting designer must work closely with the roadway designer to ensure that the plans reflect an efficient and effective method of construction.

E5.2 Lighting Design

E5.2.1 Lighting Levels Table

Lighting level design criteria are provided in Table 5.1. The lighting designer shall confirm the design speed, roadway classification, pavement class and area class with the roadway designer or Alberta Transportation prior to beginning the pre-design report. The lighting levels listed in Table 5.1 apply to the main roadway sections within the project but may require adjustments for special situations such as tunnels, crosswalks and other pedestrian areas. The lighting design requirements for these special areas are listed in separate sub-sections of this Guide.

E5.2.2 Pavement Types and Reflectance Values

For general information, refer to IESNA RP8 Page 5, Section 2.3 - Pavement Classifications.

The lighting designer shall use the appropriate R value for any known pavement class as illustrated in Table 5.2. A default of R3 shall be used when the class is unknown.

TABLE 5.1- DESIGN LIGHTING LEVELS

ROADWAY CLASS (4)	AREA CLASS (4)	LUMINANCE CRITERIA				ILLUMINANCE CRITERIA (1) (2)			
		Average	Uniformity		Glare	Average	Uniformity		Glare
		Luminance Lav (3) (cd/m ²)	Maximum Ratio (Lav/Lmin)	Maximum Ratio (Lmax/Lmin)	Maximum Lv max/ Lp av (%)	Illuminance Eav (lux)	Maximum Ratio (Eav/Emin)	Maximum Ratio (Emax/Emin)	Maximum Lv max/ Lp av (%)
Freeways	Urban	0.6	3.5:1	6:1	30	9.0	3:1	6:1	30
	Suburban/Rural	0.4	3.5:1	6:1	30	6.0	3:1	6:1	30
Expressways	Urban	1.0	3:1	5:1	30	14.0	3:1	6:1	30
	Suburban	0.8	3:1	5:1	30	12.0	3:1	6:1	30
	Rural	0.6	3.5:1	6:1	30	9.0	3:1	6:1	30
Arterials	Urban	1.2	3:1	5:1	30	17.0	3:1	5:1	30
	Suburban	0.9	3:1	5:1	30	13.0	3:1	5:1	30
	Rural	0.6	3.5:1	6:1	30	9.0	3:1	6:1	30
Collectors	Urban	0.8	3:1	5:1	40	12.0	3:1	6:1	40
	Suburban	0.6	3.5:1	6:1	40	9.0	3:1	6:1	40
	Rural	0.4	3.5:1	6:1	40	6.0	3:1	6:1	40
Locals	Urban	0.6	3:1	6:1	40	9.0	3:1	6:1	40
	Suburban	0.5	6:1	10:1	40	7.0	6:1	10:1	40
	Rural	0.3	6:1	10:1	40	4.0	6:1	10:1	40
Notes: (1) Luminance criteria shall be the primary method of report lighting levels. Illuminance may be used for roadway curves and high mast lighting situations. (2) Recommended values are meaningful only when used with supplementary recommendations. For averaging values, coverage and visual quality. These values should be increased by a factor of 1.50 for key conflict areas such as crosswalks centre of intersections and railway crossing. (3) Values are given for pavements of type R2 or R3. (4) Refer to Section E3.1 for definitions.									

TABLE 5.2 - PAVEMENT CLASSIFICATIONS

Class	Q ₀	Description	Mode of Reflectance
R1	0.10	Portland cement concrete road surface.	Mostly diffuse
R2	0.07	Asphalt road surface with an aggregate composed of a minimum 60 percent gravel	Mixed (diffuse and specular)
R3	0.07	Asphalt road surface with dark aggregates, rough texture after some months of use (typical highways).	Slightly Specular
R4	0.08	Asphalt road surface with very smooth texture.	Mostly Specular

E5.2.3 Pedestrian Classifications

Alberta Transportation does not have a specific pedestrian classification system. Pedestrian considerations are incorporated into the area classifications listed in Table 5.1. For rural and suburban highways passing through high pedestrian situations (e.g. highways adjacent to schools, playgrounds, bus depots), the lighting designer should use the next higher Area Class to account for these situations.

E5.2.4 Extent of Lighting

The lighting designer shall determine in consultation with Alberta Transportation, the extent of the roadway lighting for each proposed project. This will include an evaluation of any existing roadway lighting, an applicable lighting warrant, required minimal lighting as defined in this Guide and any other issues identified by Alberta Transportation or the lighting designer.

E5.2.5 Calculation Methods and Applications

Three distinct design and calculation methods for roadway lighting are utilized in this Guide. These methods are the *Luminance Method*, the *Illuminance Method*, and the *Small Target Visibility (STV) Method*. The preparation of lighting design calculations for roadways, signs, tunnels, and open areas can use different methods as appropriate for the specific situations.

All roadway lighting calculations shall be prepared using the *Luminance* method. A *Small Target Visibility (STV)* assessment may be done at the discretion of the lighting designer, but in all cases the lighting requirements defined in this Guide must be met.

E5.2.5.1 Luminance

The luminance method calculates the amount of light reflecting towards the observer. This is the design methodology to be used for all instances except for tunnels, signs, roadway curves and interchange areas featuring high mast lighting. The luminance method shall be the primary method of reporting light levels.

E5.2.5.2 Illuminance

The illuminance method calculates the amount of light incident on a surface. Illuminance calculations are required on roadway curves and in high mast lighting applications.

E5.2.5.3 Small Target Visibility (STV)

The STV method determines the visibility level of an array of objects on the roadway, considering the following factors:

- Luminance of the targets.
- Luminance of the immediate background.
- Disability glare.
- Adaptation level of the adjacent surroundings.

In specific instances, an STV assessment must be done. These instances shall include:

- Rural intersections
- Tunnels
- Signs

E5.2.5.4 Light Loss Factors

All lighting calculations shall be performed using the initial rated lumens of the selected lamp and the total light loss factor (LLF). Lamp lumen values for high intensity discharge (HID) lamps may be found in the appropriate lamp manufacturer's catalogue. Total light loss factors may vary depending on the geographical area and the objects to be lighted. The standardized light loss factors to

be used in roadway lighting calculations are outlined in Table 5.3.

E5.2.5.5 Computer Simulations and Software

The lighting designer shall prepare all roadway lighting designs using computer programs that have been developed for the specific purpose of roadway lighting design.

E5.2.5.6 Minimum Criteria for Software

Roadway lightning analysis software must meet the requirements of all IESNA design methodologies and design criteria. As a minimum, it shall be capable of performing illuminance, luminance and STV calculations.

Lighting analysis software must be able to calculate and analyze lighting levels, uniformity, and glare. Not all lighting programs will adequately calculate all types of lighting designs.

Some roadway lighting programs may not be adequate for the design of lighting in areas such as parking lots and rest areas if they cannot calculate the lighting on vertical surfaces.

Sign lighting and floodlighting software must

be able to calculate the lighting on vertical surfaces.

When computer lighting calculations are being performed, lighting designers shall use the luminaire manufacturer's IESNA formatted photometrics for the lighting calculations. IESNA formatted photometrics are generally provided in digital file by the luminaire manufacturer upon request.

E5.2.5.7 Calculation Area

A grid shall define the extent of the lighting calculation area. The area of the calculation grid shall be determined in accordance with the requirements of Table 5.4 and Drawing TCS-E-540 at the end of this section.

E5.2.5.8 Reporting

A report describing the existing, minimum and proposed lighting levels shall be provided. Table 5.5 illustrates the basic format and type of information that should be included.

TABLE 5.3 - LIGHT LOSS FACTORS

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
Notes: (1) This applies to most areas of the Province. This is the default LLF. (2) Typically areas with heavy industrialization. (This classification is rarely used and applies only to very few heavily industrialized areas in the Province. Furthermore, these industrial areas must be producing a significantly high level of airborne particulate matter. This classification may only be used if confirmed with Alberta Transportation and may require further reduction in tunnels) (3) Based on a 4-year maintenance cycle. (4) Degradation of the reflector and refractor. (5) Effect of ambient temperature, voltage fluctuations, and the ballast and lamp factors.					

TABLE 5.4 – LIGHT CALCULATION GRID DEFINITIONS

AREA	GRID SPACINGS
Roadway (straight sections and curved sections)	2 m grid, centred on the roadway, extending laterally from lane edge to lane edge.
Intersections	2 m grid, centred on the intersection, extending laterally from lane edge to lane edge.
Bridges and Overpasses	2 m grid, centred on the roadway, extending laterally from lane edge to lane edge.
Interchanges	Interchange components as described above.
Rest Areas and Vehicle Inspection Stations	2 m grid, to cover the entire travel portion of the roadway and parking area.
Signs	300 mm grid on the face of the sign.
Vehicle Tunnels	Refer to IESNA PR-22

TABLE 5.5 – LIGHT CALCULATION REPORTING FORMAT

	Avg Luminance Lav (cd/m ²)	Max Uniformity Ratio Lav/Lmin	Max Uniformity Ratio Lmax/Lmin	Max Glare Lv max/ Lp av (%)
Existing adjacent lighting levels				
Required minimum lighting levels				
Proposed lighting levels Option 1				
Proposed lighting levels Option 2				

E5.3 Standard Pole Placement

This section gives basic methodologies for the standard cases. Sample layouts are provided at the end of this section.

Standard or uniform pole spacing may be difficult to achieve in situations such as highways passing through municipalities. For these urban design situations where the highway right of way is constrained, the number of obstructions and clearances to consider may preclude maintaining a strict pole placement configuration. In these situations the following steps shall be undertaken:

- Identify the best pole size and type with matching luminaire(s) to yield the required light levels for the roadway type and width.
- Calculate a theoretical best pole configuration and optimum spacing.
- Position critical poles within the project area and fill in between these critical locations with poles at or near optimum spacing.
- Perform adjustments to meet necessary clearances to all other facilities in the area while maintaining required lighting levels.
- Consideration shall be given to overall aesthetics including aligning poles in straight lines whenever possible to complement the finished appearance of the roadway.

E5.3.1 Pole Setback

E5.3.1.1 Rural Areas

The standard pole setback in rural areas shall be 5.0 m from the edge of the through lane (white line) to the face of the lighting pole. This will accommodate all design speed conditions up to 120 km/h, and requires that a breakaway base assembly be used. Any deviation from this standard shall be

documented and described in the pre-design report. The following exceptions may apply:

- A roadway design speed greater than 120 km/h may require an increased setback.
- The pole is protected by a barrier, in which case the minimum setback may be reduced to the value of the deflection shown in Table 5.6.
- Urban or other congested areas where a clearance conflict between the lighting pole and other infrastructure exists.
- High mast poles which requires greater setback and/or barrier protection.

Figure 5.1 shows permitted exceptions to the pole setback for various pole and area types.

The use of a breakaway base assembly is preferred in all areas where there is sufficient room for the pole to fall away in the event of a collision. However, in specific urban locations, where a falling pole may cause an additional hazard, a breakaway base assembly will only be allowed by special permission.

The setbacks shown are minimums only and may be exceeded. When a suitable barrier exists ("W" beam, concrete barrier or other) between the base and the through lane, then the base may be placed just behind the deflection point (zone) of the barrier described in Table 5.6. It is not the intent of this exception to actively promote the addition of barriers to avoid pole setbacks as the barriers themselves are an additional collision obstacle for the motorist. The setbacks are measured from the edge of the through lane to the face of the pole. Acceleration or deceleration lanes

or tapers at on and off ramps shall be considered as through lanes of the highway up to the gore point of the entry and exit terminals.

The minimum set back for "unprotected" high mast poles shall be 15 m from the edge of a through lane. In situations where the high mast pole is located in an area above the driving surface (i.e. a cut area) this distance may be reduced to the values in Figure 5.1.

E5.3.1.2 Urban Areas

The standard pole setback in urban areas shall be 3.0 m from the face of curb to the centre of the lighting pole. This will allow for the placement of a sidewalk or landscaping between the pole and roadway.

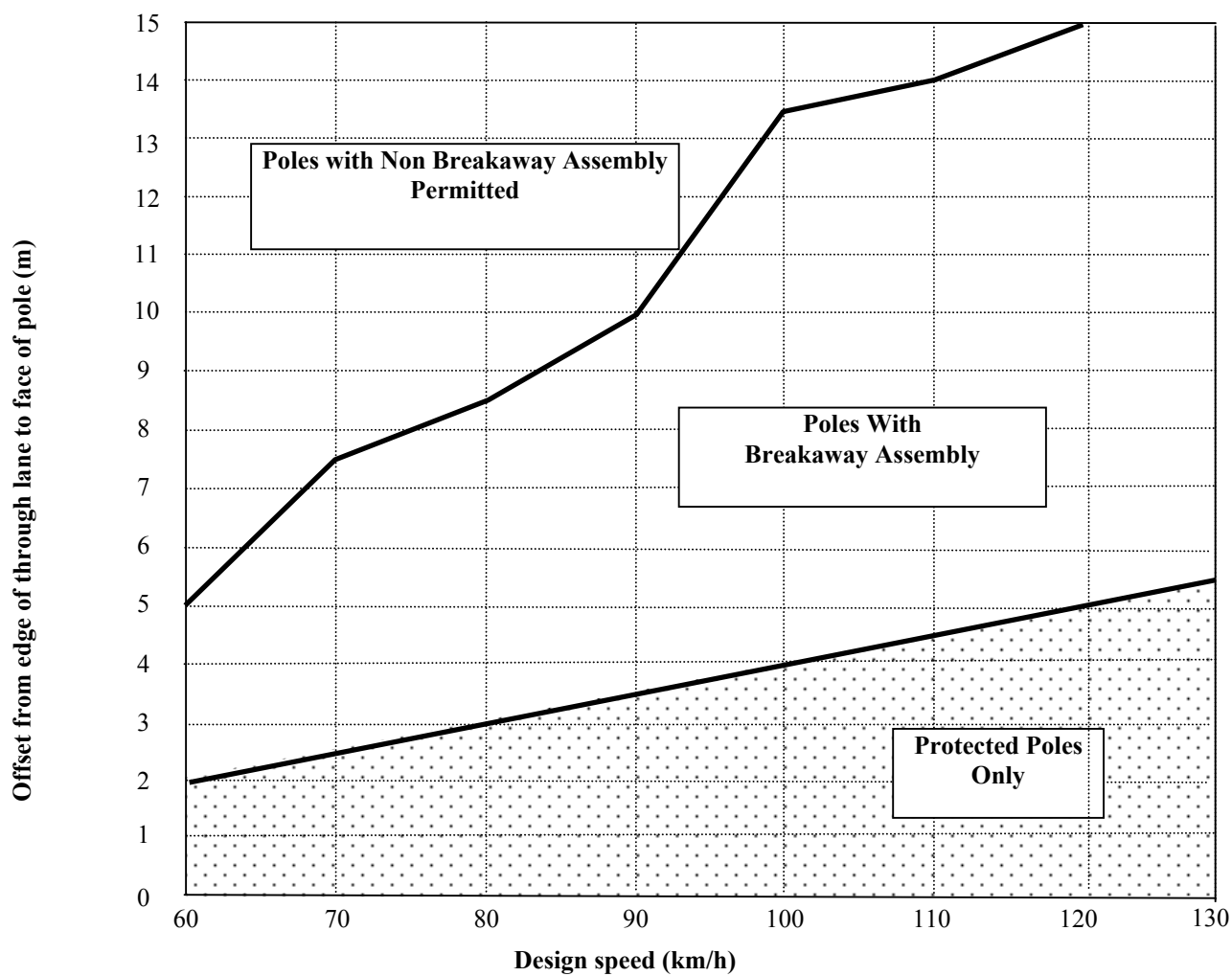
The pole setback may be reduced to as low as 0.5 m where the design or posted speed is 60 km/h or less and there is limited road right-of-way.

For urban and suburban areas without curb and gutter, the pole offset should meet the requirements in Section E5.3.1.1.

TABLE 5.6 - BARRIER DEFLECTION

Barrier Type	System Type	Deflection
3 Strand Cable	Flexible	3.0 m
W-Beam (Weak Post)	Flexible	2.5 m
W-Beam (Strong Post)	Semi-Rigid	1.5 m
Box Beam	Semi-Rigid	1.5 m
Concrete	Rigid	0.0 m

FIGURE 5.1 - ALLOWABLE POLE SETBACKS



E5.3.2 Lighting Distribution Types

Luminaires with a Type 2 lighting distribution (long and narrow) should be used for 2 lane highway situations and single lane on and off ramps.

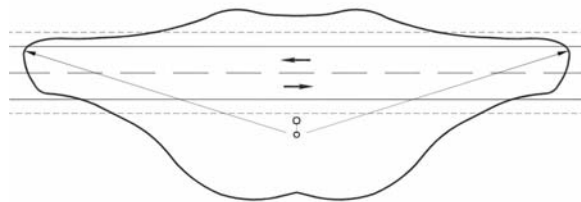
Luminaires with a Type 3 distribution (shorter but wider than Type 2) should be used for large intersections and multi-lane highway conditions.

Luminaires with a Type 4 lighting distribution (shorter but wider than Type 3) should be used in high mast lighting applications, generally in a multi-fixture configuration.

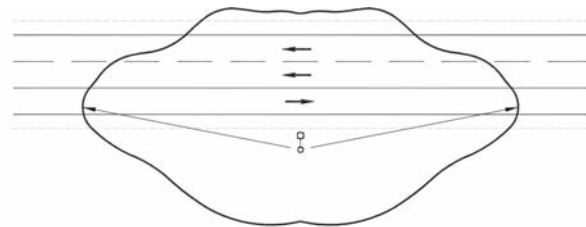
Type 5 lighting distributions are circular. Fixtures with a Type 5 distribution should be used in parking lot and rest area applications.

Pole height, setback and spacing will influence the selection of luminaire with the appropriate lighting distribution. Figure 5.2 illustrates some of the various lighting distribution types.

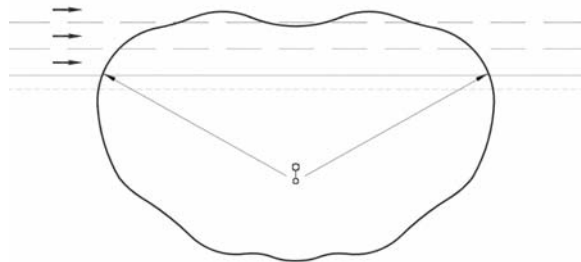
FIGURE 5.2 - LIGHTING DISTRIBUTION TYPES



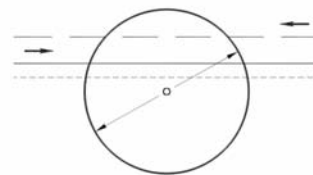
TYPICAL TYPE 2
DISTRIBUTION



TYPICAL TYPE 3
DISTRIBUTION



TYPICAL TYPE 4
DISTRIBUTION



TYPICAL TYPE 5
DISTRIBUTION

E5.4 Standard Lighting Applications

The following section gives the basic methodologies for the typical lighting applications. Sample layouts are provided at the end of this section.

E5.4.1 Continuous Lighting

Lighting Requirements

The lighting warrants for straight and curved sections of roadways between intersections and interchanges can be found in Section E4.2.1.

Lighting Materials

Straight and curved road sections shall be illuminated using standard semi-cutoff cobra head luminaires and davit poles.

Lighting Design

Continuous lighting may be provided on one side, both sides (staggered or opposite), or in the median (see Drawing TCS-E-501). The general criteria for each configuration is as follows:

One Side Two lane highways

Both Sides Multi lane highways with centre turn lanes or medians less than 10 m in width

Median Multi lane highways with medians greater than 10 m in width

E5.4.2 Intersection Lighting

Lighting Requirements

The lighting designer shall determine the type of intersection, the warrant for lighting at the intersection and, if lighting is required, the extent of the lighting. Full, partial or delineation lighting shall be provided as warranted.

Lighting Materials

Intersections shall be illuminated using standard semi-cutoff cobra head luminaires and davit poles.

Lighting Design

Sample lighting layouts for intersection types are shown in Table 5.7.

TABLE 5.7 - TYPICAL INTERSECTION LAYOUTS

Alberta Transportation Intersection Type	Drawing
Ia, IIa, IIIa, IVa, IVd	TCS-E-510.1
Ib, IIb, IIc, IIIb, IIId, IVb, IVc, IVd	TCS-E-510.2
Vb, Vc	TCS-E.510.3

Each drawing shows a typical pole configuration for delineation, partial and full lighting conditions.

Intersection lighting layouts for multi lane highway intersections are shown in Drawings TCS-E-510.4 and TCS-E-510.5

E5.4.3 Highway Interchange Lighting

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 an arterial 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.

Lighting Requirements

The lighting warrants for highway interchanges can be found in Section E4.2.4.

Interchanges that require full or partial lighting, as determined by the warrants, shall be designed to meet the lighting level requirements of Table 5.1.

Lighting Materials

Interchanges may be illuminated using standard semi-cutoff cobra head luminaires and davit poles, high mast lighting or a combination of both.

The application of high mast lighting must be clearly justified in the pre-design report and must take into consideration the potential light trespass impacts to adjacent properties.

Lighting Design

Typical layout configurations for poles on straight road sections are shown in Drawing TCS-E-501.

Typical layout configurations for poles on curved road sections are shown in Drawing TCS-E-505.

Should high mast lighting be used, Drawing TCS-E-515.1 provides the recommended pole positioning philosophy to be followed.

The typical lighting layouts for other interchange components; on-ramps, off-ramps and gore areas; are provided in Drawings TCS-E-515.2 to TCS-E-515.4.

E5.4.4 Bridge and Overpass Lighting

Lighting Requirements

The lighting warrants for roadways on bridges and overpasses can be found in Section E4.2.5.

Lighting levels for lighting along bridge roadways follows the same requirements as the roadway lighting at either end of the bridge. Refer to Table 5.2 for lighting level requirements.

Lighting Materials

Roadways on bridges and overpasses shall be illuminated, in most cases, using standard semi-cutoff cobra head luminaires and davit poles.

Where bridges or overpasses are part of interchanges with high mast lighting, the need for davit lighting may be eliminated.

Lighting Design

Recommended locations for poles on roadways on bridges and overpasses are shown on Drawing TCS-E-515.5.

E5.4.5 Pedestrian and Bicycle Tunnel Lighting

Lighting Requirements

As there is not a specific lighting warrant for pedestrian and bicycle tunnels, the lighting designer shall always confirm the requirement for lighting with Alberta Transportation.

The recommended lighting levels for bicycle tunnels are the same as those for pedestrian tunnels on the assumption that any tunnel suitable for pedestrian use may also be used by bicycle traffic. Therefore, the lighting designer shall obtain the appropriate facility use from the roadway designer. For lighting purposes, tunnels shall only be designated as bicycle tunnels if the cyclists can travel through the tunnel by riding and are not forced to dismount at the entrance of the tunnel.

Pedestrian and bicycle tunnels shall be illuminated to full design lighting levels as defined in Table 5.8. Luminaires shall be controlled at night using a photocell and a normally closed relay located in the service panel. In special cases Alberta Transportation may require that the lighting remain at full levels both day and night.

**TABLE 5.8 - LIGHTING LEVELS FOR
PEDESTRIAN AND BICYCLE TUNNELS**

	E_H (lux)	E_{Vmin}	E_{av}/E_{min}
Day	100	50	3.0
Night	40	20	3.0

Lighting Materials

There are no specific material requirements or methods with respect to pedestrian and bicycle tunnels. The selection of the type of luminaire, mounting location, wattage and distribution forms a major part of the tunnel lighting design process and should be researched and documented in the pre-design report.

Lighting Design

Recommended locations for luminaires in pedestrian and bicycle tunnels are shown on Drawing TCS-E-520.

A luminaire spacing of 3.0 m will generally provide adequate illumination for pedestrian and bicycle tunnels with a 3.0 m wide walkway. The lighting designer shall confirm

actual spacing and achieved lighting levels by calculation.

Pedestrian and bicycle tunnels require lighting at the entrances and exits of the structures. Refer to the section on Walkway Lighting for details on walkway lighting. For tunnels that are in areas of non-continuous lighting, one post-top walkway light will be required at a strategic location near each end of the tunnel. For tunnels that are in the vicinity of roadway lighting, strategically placed roadway luminaires should provide adequate lighting at the tunnel entrance and exit.

E5.4.6 Vehicle Tunnel and Underpass Lighting

Lighting Requirements

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

The lighting warrants for vehicle tunnels and underpasses can be found in Section E4.2.6.

The lighting designer shall always confirm the requirement for lighting with Alberta Transportation.

All vehicle tunnel projects are considered to be special projects and, as such, require project specific research into the best solutions for the lighting design.

All tunnel lighting systems shall be designed to meet the lighting design criteria and requirements of IESNA RP-22 - American National Standard Practice for Tunnel Lighting.

Lighting Materials

There are no specific material requirements or methods with respect to vehicle tunnels. The selection of the type of luminaire, mounting location, wattage and distribution forms a major part of the tunnel lighting design

process and should be researched and documented in the pre-design report. 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 will not be permitted.

For minor tunnel projects, high pressure sodium or metal halide luminaires shall be used.

Where possible, lighting inside underpasses 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.

Where specific fixtures are required for underpass lighting, they shall be selected with special attention paid to the veiling luminance design criteria.

Lighting Design

The lighting design and calculations shall be undertaken by using the methods outlined in IESNA RP-22 American National Standard Practice for Tunnel Lighting. The lighting design criteria and design methods vary depending on the size, length, and geographical area of the tunnel. The lighting designer shall determine the lighting design criteria and select the most appropriate method for lighting the tunnel or underpass. 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 LSEQ (Equivalent Veiling Luminance) Method as outlined in Annex B of IESNA RP-22.
- For minor tunnels the threshold

luminance values, L_{th} , may be determined by using the standard tables included in IESNA RP-22 Section 6 Lighting Design Criteria, including the table of adjustment factors, however, the LSEQ 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 analyses 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 IESNA 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 and ongoing operational costs. Recommendations for these considerations are outlined in IESNA RP-22.
- Energy efficiency is a key factor in a tunnel lighting design given the large quantity of luminaires 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 daytime lighting levels and a separate nighttime lighting level.

- Lighting is required for the external approach zone and exit zone of all tunnels that warrant nighttime lighting. The lighting design criteria for these areas are outlined in IESNA RP-22.
- Research and development of new tunnel lighting design criteria and design methods are continuously ongoing by the IESNA as well as other lighting engineering research groups from Europe. All new design methods and criteria, even if not officially adopted by the IESNA, 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 prior to proceeding with the detailed design.

Where light fixtures are required to be installed in underpasses, or beneath overpasses, they shall be located in accordance with the recommendations of Drawing TCS-E-515.5.

E5.4.7 Walkway and Bikeway Lighting

Lighting Requirements

As there is not a specific lighting warrant for walkways and bikeways, the lighting designer shall always confirm the requirement for lighting with Alberta Transportation. Table 5.9 provides the required lighting levels for walkways and bikeways.

If a walkway or bikeway runs adjacent to a roadway lighting system, the lighting designer shall determine whether spill lighting from the roadway lighting system

provides adequate lighting on the walkway or bikeway.

TABLE 5.9 - LIGHTING LEVELS FOR WALKWAYS AND BIKEWAYS

Area Class	E_H (lux)	E_{Vmin}	E_{av}/E_{min}
Urban	20.0	10.0	4.0
Suburban	5.0	2.0	4.0
Rural	2.0	0.6	10.0

Lighting Materials

Lighting systems for walkways and bikeways requiring a separate lighting system shall be designed using 100 W HPS Post Top Luminaires mounted on 6.0 m straight shaft poles. Luminaires with either Type 3 or Type 5 distribution, as appropriate, may be used. All lighting shall be high-pressure sodium.

In locations where light trespass is an issue, 250 W flat glass cobra head luminaires mounted on 13.0 m davit poles may be provided.

Lighting Design

In situations where a designated walkway or bikeway lighting system is required, a pole layout similar to that recommended on Drawing TCS-E-525.

E5.4.8 Rest Area Lighting

Lighting Requirements

The objective of rest area lighting is to provide a safe and comfortable facility for the nighttime use of the traveling public and the rest area service personnel.

The lighting warrants for rest areas can be found in Section E4.2.8.

Recommended illumination design levels for rest areas are shown in Table 5.10.

Lighting Materials

Rest areas, including entrances and exits, shall generally be illuminated using standard semi-cutoff cobra head luminaires and davit poles or post top luminaires and straight poles. All lighting shall be high-pressure sodium.

Lighting Design

Lighting within the boundaries of rest areas shall be designed in accordance with the recommendations detailed in IESNA CP-38.

Lighting for rest area on-ramp/off-ramp style entrances and exits shall generally meet the requirements described in Drawings TCS-E-515.2 and TCS-E-515.3.

Where the rest area entrances and/or exits are configured as intersections, pole layout shall meet the recommendations of Drawing TCS-E-510.1.

E5.4.9 Vehicle Inspection Stations

Lighting Requirements

The objective of vehicle inspection station lighting is to increase worker safety, and for inspection station operators to perform inspections of vehicles in the facility.

The lighting warrants for vehicle inspection stations can be found in Section E4.2.9.

Table 5.10 provides the required illuminance levels for vehicle inspection stations

Lighting for vehicle inspection station on and off ramps to a freeway or expressway facility shall meet the requirements of freeway interchange ramps described in Drawings TCS-E-515.2 and TCS-E-515.3.

Lighting of the entire vehicle inspection station is only required for the time of night that the facility is operational. Time programmable controls may be used to downgrade the lighting to security levels when the facility is non-operational.

Lighting Materials

Weigh scales shall be illuminated using standard semi-cutoff cobra head luminaires and davit poles or post top luminaires and straight poles. Highmast lighting may also be used for lighting large weigh scale facilities.

All lighting shall be high-pressure sodium. Any inspection area specialty lighting where good colour rendition is required, will be

provided by others, and is not considered part of the roadway lighting.

Lighting Design

Lighting within the boundaries of vehicle inspection area shall be designed in accordance with the recommendations detailed in IESNA CP-38 and IESNA RP-20.

**TABLE 5.10 - ILLUMINANCE LEVELS FOR
REST AREAS AND VEHICLE INSPECTION STATIONS**

AREA DESCRIPTION	LUMINAIRE TYPE	REST AREAS		VEHICLE INSPECTION STATIONS	
		LUX (AVG)	UNIFORMITY (AVG:MIN)	LUX (AVG)	UNIFORMITY (AVG:MIN)
Interior roads (Ingress and Egress roads)	Cobra head (flat glass)	12.0	6:1	15.0	6:1
Parking Area	Cobra head (flat glass)	12.0	6:1	20.0	3:1
Public Areas (walkways, washrooms, telephone, info areas)	Post Top	22.0	6:1	N/A	N/A
Inspection Area	Cobra head (flat glass)	N/A	N/A	30.0	3:1
Lighting Weigh Scales	Wall mount on buildings or cobra head	N/A	N/A	50.0	3:1
On/Off Ramps		Refer to TAC for luminance levels.			

Certain site conditions may require modification of the lighting levels as defined by Alberta Transportation

E5.4.10 Mid-Block Pedestrian Crosswalks**Lighting Requirements**

The lighting warrants for pedestrian crosswalks not associated with intersections can be found in Section E4.2.3.1.

The lighting designer shall confirm the requirement for lighting at non-intersection pedestrian crosswalks with Alberta Transportation.

Lighting Materials

Non-intersection pedestrian crosswalks shall be illuminated using standard semi-cutoff cobra head luminaires and davit poles. All lighting shall be high-pressure sodium.

Lighting Design

Where lighting is required for non-intersection pedestrian crosswalks, a pole layout similar to that recommended on Drawing TCS-E-530 shall be used.

E5.4.11 Railway Crossing Lighting

Lighting Requirements

The lighting warrants for at-grade railway crossings can be found in Section E4.2.3.4.

The lighting designer shall always confirm the requirement for lighting at at-grade railway crossings with Alberta Transportation.

Lighting Materials

At-grade railway crossings shall be illuminated using standard semi-cutoff cobra head luminaires and davit poles. All lighting shall be high-pressure sodium.

Lighting Design

Where lighting is required for at-grade railway crossings, a pole layout similar to that recommended on Drawing TCS-E-535 shall be used.

E5.4.12 Highway Lighting Near Airports

Roadway lighting in the vicinity (within approx. 2 km) of airports must comply with Transport Canada's Aerodrome Standards and Recommended Practices. The lighting designer must apply to Transport Canada's Safety Branch in Edmonton (780) 495-3850 for approval of the proposed roadway lighting.

The lighting designer shall use the applicable edition of the Aerodrome Standards and Recommended Practices to determine the anticipated clearances from the airport in the roadway lighting design. It is important to note that the listed clearances are only a starting point for the application process and that the Transport Canada Safety Branch may put forward other requirements prior to issuing approval.

Further information is available at the Navigation Canada website:

http://www.tc.gc.ca/aviation/regserv/carac/CARS/html_e/doc/nav-2040.htm

The local airport operator or manager should be contacted to determine factors that may affect the clearance calculation:

- "Zoning" regulations, which may include caveats on nearby property including road allowances. Zoning may indicate airport and/or runway planned expansions or future allowances.
- Certification and/or registration of the airport and classification of the affected runway(s).
- The basic clearance requirements can be found in the applicable edition of the Aerodrome Standards. It must be determined if the classification is a "non-instrument" or a "non-precision" approach or a "precision approach". All approaches to the runway must be considered and calculated.

Custom poles may be necessary in situations where the pole height of the proposed roadway lighting is very close to infringing on the obstacle limitation surface. Shorter poles may avoid the need for the use of the red aircraft warning lights on top of the poles.

The pre-design report shall provide an analysis of any custom pole configuration and outline recommendations on how to provide the lighting requirements while accommodating the height restrictions near the airport. See Appendix D for an example of airport clearances required.

E5.4.13 Sign Lighting

Lighting Requirements

The lighting warrants for signs can be found in Section E4.2.7.

Recommended lighting design criteria for sign lighting is shown in Table 5.11.

**TABLE 5.11 - ILLUMINANCE AND LUMINANCE
LEVELS FOR OVERHEAD SIGNS**

Area Class	Maintained Illuminance (LUX)	Maintained Luminance (cd/m ²)
Rural	13.0	20.0
Suburban	26.0	40.0
Urban	52.0	80.0

The above design criteria apply only to signs with high intensity retro-reflective sheeting material.

Lighting Materials

Sign lighting shall be provided utilizing metal halide luminaires specifically designed for the illumination of vertical faces.

Lighting Design

Lighting for signs shall be designed in accordance with the recommendations detailed in IESNA RP-19.

Lighting calculations are required for all sign lighting designs to determine the number of sign luminaires and to ensure that the lighting design criteria are met.

The lighting designer must specify on the design drawings the type of sign luminaire to be used on each sign. The designer must also show the sign luminaire aiming angles on the design drawings in order that the lighting contractor properly orients the sign luminaires in the field. These aiming angles shall be indicated on the sign structure elevation.

Sign luminaires shall generally be mounted on the bottom of the signs. In areas sensitive to light pollution and sky glow, the sign luminaires may be placed on the top the signs, in order to reduce the upward component of light into the sky.

E5.5 Clearance Approvals

Roadway lighting poles, bases and cabling must maintain specific clearances from other nearby infrastructure such as road accesses, overhead or underground power or communication lines and poles, underground gas (low and high pressure), water (cold mains and irrigation), sanitary sewer and storm sewer lines. See Appendix E for a checklist.

Various utility owners (electric, gas, water, etc) have policies in place, which dictate the required clearance(s) to roadway lighting poles, bases and associated cabling. These required clearances may supercede applicable code requirements. Table 5.12 suggests generic horizontal clearances to be used as a starting point for design clearances. However, the clearances suggested may not be suitable for all locations. The lighting designer shall become familiar with each utility owner and obtain the minimum required horizontal and vertical clearances for the specific project.

**TABLE 5.12 - GENERAL
HORIZONTAL UTILITY CLEARANCES**

Utility	Horizontal Clearance (m)
Overhead Electrical	6
Underground Electrical	1
Communications (Telephone and Cable)	1
Underground Fiber Optic	5
Natural Gas Low Pressure (690 kPa or less)	1
High Pressure Lines (Gas or other) (> 690 kPa)	5
Sewer Lines (storm or sanitary)	3
Water Mains	3
Private Irrigation	0.3

Some clearances or crossings may be covered by blanket approvals while others require site specific crossing agreements, such as high pressure gas lines (HPG).

E5.5.1 Leased Lighting on Utility Power Poles

Wherever possible, roadway lighting systems shall be installed on poles specifically designated for that purpose. These poles shall be owned and maintained by Alberta Transportation.

Lighting systems on utility poles are permitted in cases where there is an existing utility line adjacent to a highway and the location of the utility line precludes the safe installation of separate roadway lighting poles. In many cases, the local utility imposes height restrictions on the lights to allow for vertical clearances to the high voltage wires.

If the use of leased utility poles is the only means of providing the roadway lighting, the lighting designer must address the following issues as part of the lighting design and negotiations with the utility owner:

- Ownership.
- Allowable mounting height of the luminaire.
- Adequacy of the utility pole spacing in relation to the roadway lighting design.
- Location of power source and disconnect.
- Access for maintenance.

E5.6 Electric Power Source

E5.6.1 Panel Sizing Calculations

The minimum conductor sizes and maximum overcurrent protection rating shall be per the latest CSA standard C22.1 and shall be used when selecting breakers and wiring. Single phase and three phase services shall have

nominal ratings that accommodate existing and future loads. A minimum of 25% spare capacity shall be available to accommodate future loads. The aggregate load demand including future loads shall not exceed 80% of the rating of the panelboard.

The minimum number of lighting panelboard positions is dependent on the number and size of loads being supplied. The minimum number of single pole breaker positions required shall be as determined based upon loading or 12 whichever is larger.

The minimum rating of the lighting panelboard bus shall be as determined based upon loading or 60 A whichever is larger. The panelboard bussing shall be made of copper and be either single phase three wire or three phase four wire.

E5.6.2 Panel controls and uses

Each lighting circuit shall be controlled through a lighting contactor. The lighting contactor(s) shall be controlled by a Hand-Off-Auto (HOA) switch with the photocell in the "auto" circuit and mounted near or on the distribution equipment. The photocell shall control the contactor and inhibit or permit the energization of the lighting circuits using a normally closed wiring configuration to force the lights "on" if a failure occurs.

In projects that contain multiple circuits, the contactor may be changed to one main panelboard contactor as long as unswitched loads are allowed for.

E5.6.3 Allowing for Other Power Requirements

Provisions within the electrical distribution system shall be made available for 120 V control power, at least one 120 V distribution equipment outlet and any specified non-lighting contactor switched loads.

E5.6.4 Voltage Drop

Voltage drop shall be limited to a maximum of 5% of the nominal supply voltage. Voltage calculations shall be performed to verify that maximum allowable voltage drops have not been exceeded. The calculations are to be based upon the type of conducting material (copper or aluminum), an ambient temperature of 30° C, the cross sectional area of the conductor, the length of the conductor (supply and return), the type of insulation covering the conductor, an AC frequency of 60 Hz and the magnitude of the current flowing in the circuit. Field-testing shall be done to verify that the voltage to the load does not drop below acceptable values.

Acceptable calculation methods include CSA C22.1 Table D3, Ohm's law and computerized programs designed to calculate voltage drops.

E5.7 Power Application Procedures

E5.7.1 Wire Service Provider (WSP)

One of several Wire Service Providers within Alberta will provide the roadway lighting power connection service. The WSP must be involved early in the design process to obtain the physical power services at the roadway lighting location. The WSP will provide all required high voltage power lines and transformers to bring the power source to the point of delivery.

Each WSP will require load and site information for the roadway lighting project including:

- Project location description. This location description must be consistent throughout the course of the project and continue into billing. It should include the land legal description, highway number, highway section and closest town or city. Lighting through a municipality should include the

street or avenue address. The location description shall be confirmed by the Alberta Transportation Operations Manager prior to submission to the WSP.

- Power service type (single phase 120/240 V or other)
- Power service size (125 A or other)
- Power cabinet preferred location(s) drawn on a site plan. A preferred location may be favored to aid in the control of voltage drop.

The lighting designer will require various information from the WSP concerning the site and any specific company policies that the WSP may have including:

- Site requirements and/or responsibilities. (The WSP may require that the lighting contractor supply and install the secondary cable from the transformer to the meter in the power cabinet.)
- Availability of one site ID number for each meter within a power cabinet. (There may be a requirement for one site ID number for every single light location.)
- Timing window for the WSP to design the power services to the site.
- Timing window for the WSP to construct the power services to the site. (In locations where power is not readily available, this timing window may be substantially longer than a site where power already exists).
- Cost of the power service to the site location(s). (The WSP may cover part of the cost as an investment in the electrical load and charge only the costs above this calculated amount).
- Expected electrical fault levels at the meter.
- Acceptance of a flat rate for each luminaire wattage type. (The WSP may require that a metered rate be used.)

Refer to Appendix F for a power (transformer) application checklist to be used with the local WSP.

Note that the WSP is a separate entity from the energy retailer even if they have the same company name.

E5.7.2 Energy Retailer

The Energy Retailer is the company contracted to supply energy or power to Alberta Transportation. This Retailer may change depending on the energy contract at the time; therefore the lighting designer shall confirm the name of the Energy Retailer.

The application to the Energy Retailer requires completing and submitting an enrollment form in accordance to the following steps:

- Obtain from the WSP, the site identification number(s). Refer to the procedures listed in Section E5.7.1.
- Fax the completed application form to the Retailer and to Alberta Transportation. The application fax should provide all information required.
- The Energy Retailer will prepare an Amending Agreement based on the application received and will forward this Amending Agreement to Alberta Transportation.
- Alberta Transportation will sign the Amending Agreement and return a signed copy to the Energy Retailer.
- The Energy Retailer enrolls the account and notifies the WSP of the energization request. The entire process typically requires a maximum of 20 business days to complete the order and energize the roadway lights.
- The Energy Retailer returns a copy of the Amending Agreement to Alberta Transportation (or other owner as

appropriate) confirming that the account has been enrolled.

- After the lighting contractor has installed the bases, poles, luminaires, wiring and power cabinets, the lighting system can be inspected. When the approved inspection tag is installed at the power cabinet, the system is ready for energization. This process physically involves only the switching "on" of the power and the installation of a meter. This service is performed by the WSP but the application for energization shall be made through the Energy Retailer.

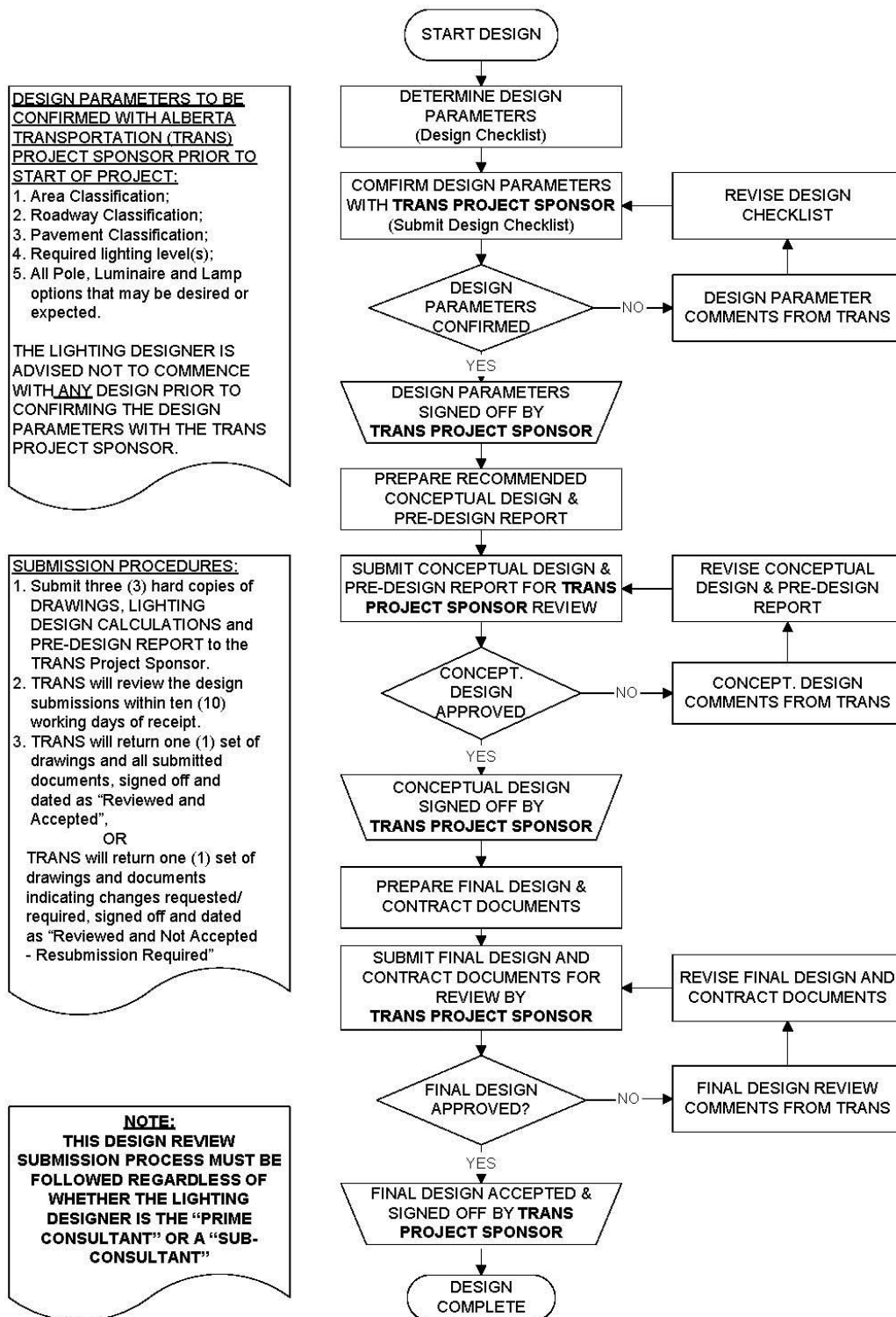
After the roadway lights are energized, the system shall be tested and commissioned as described in E7.

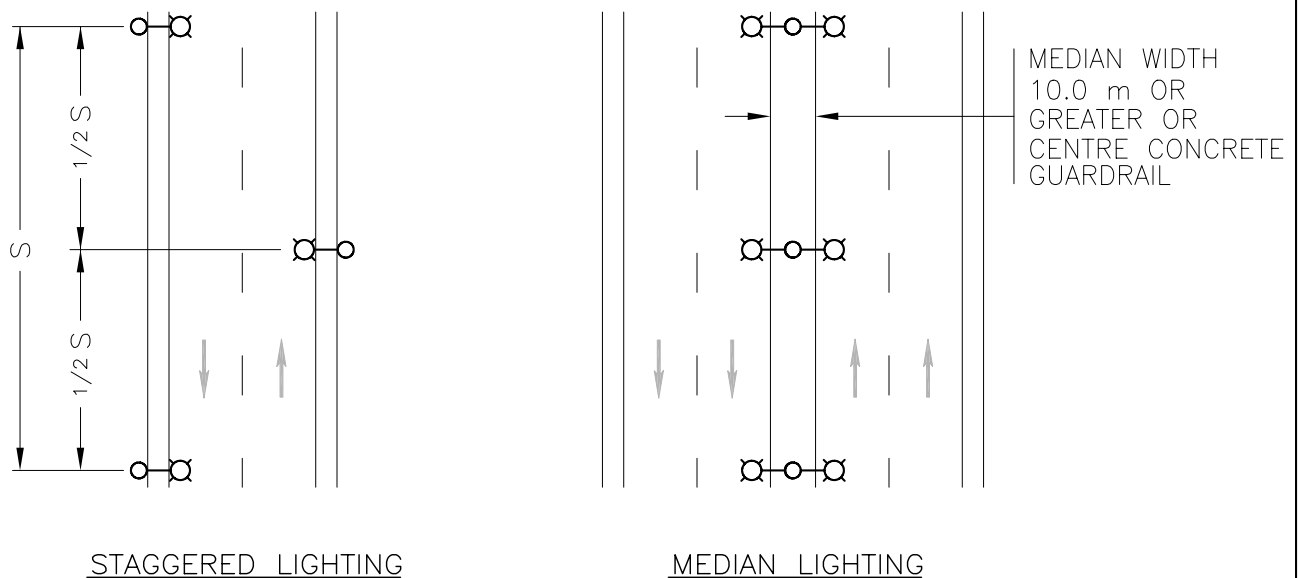
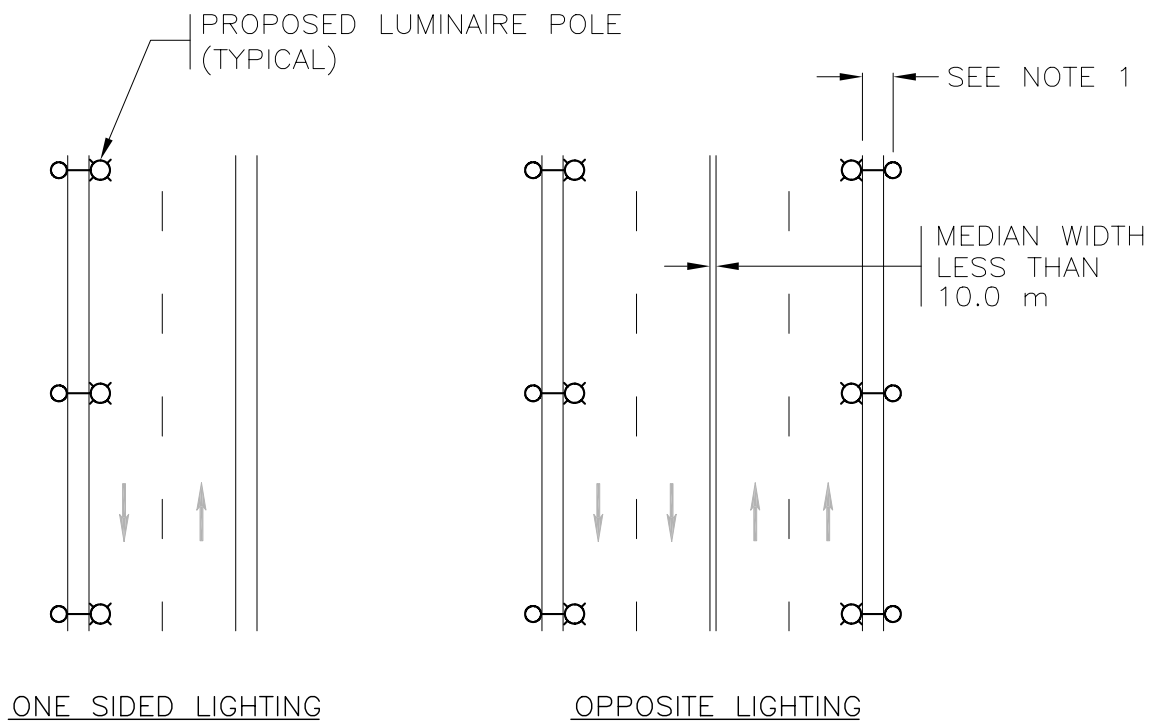
Refer to Appendix G for a power (energy) application checklist to be used with the retailer.

E5.8 Design Flowchart

Figure 5.3 shows the roadway lighting design process in flowchart form.

FIGURE 5.3 - REQUIRED ROADWAY LIGHTING DESIGN FLOWCHART





NOTES:

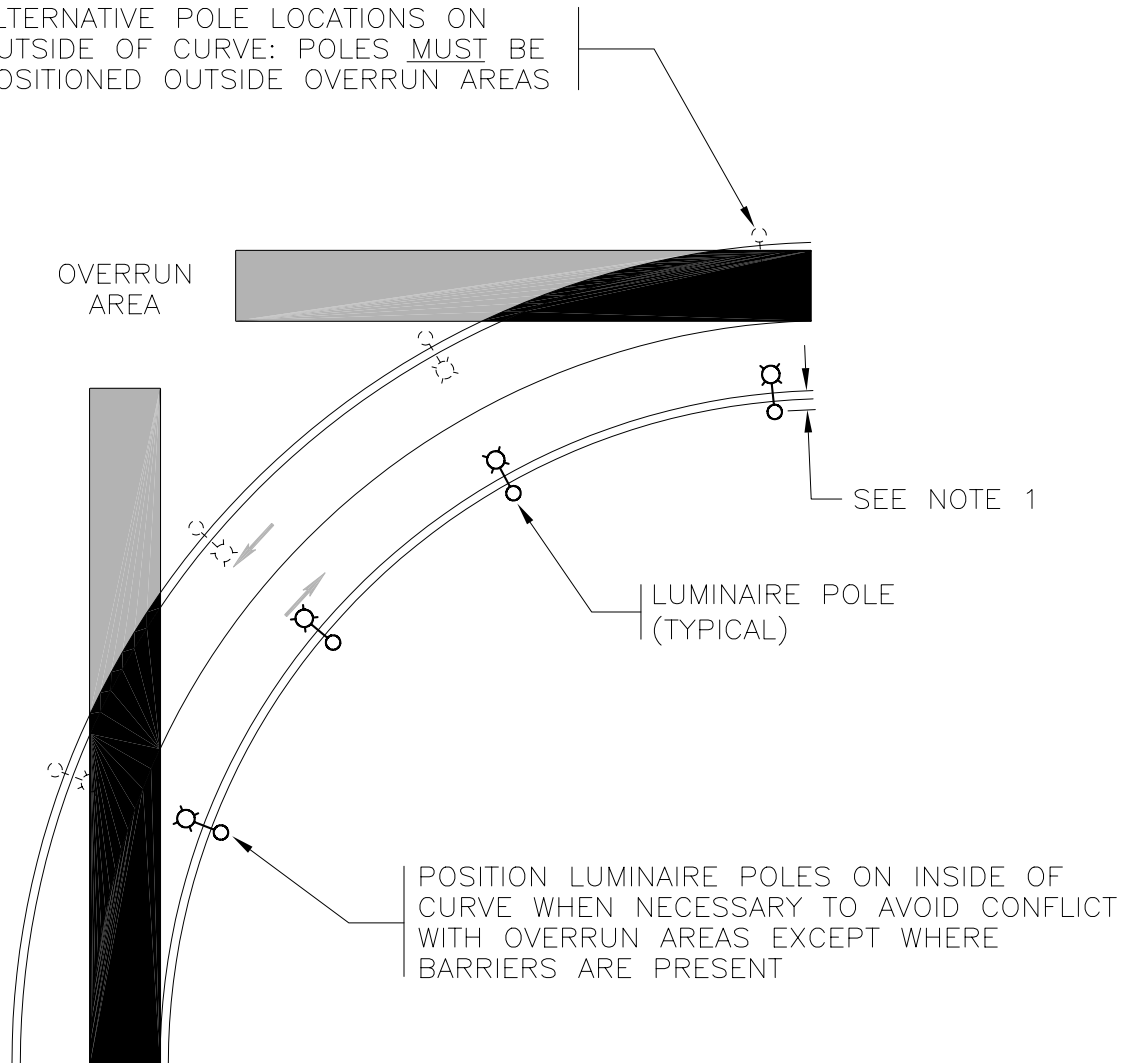
1. POLE SETBACKS TO BE DETERMINED BY APPLICATION OF SECTION E5.3.1 AND FIGURE 5.1.
2. DESIGN LIGHTING LEVELS PER TABLE 5.1.
3. LIGHTING DESIGNER SHALL CONFIRM ALL POLE LOCATIONS BY CALCULATION AND ADJUST FINAL POLE POSITIONS ACCORDINGLY.

DIMENSIONS ARE MILLIMETRES
UNLESS OTHERWISE NOTED




No.	DESCRIPTION	BY	DATE
		DRAWING TCS-E-501	
		Date:	MAR 2003
ROADWAY LIGHTING TYPICAL DAVIT LUMINAIRE POLE LAYOUTS			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E5

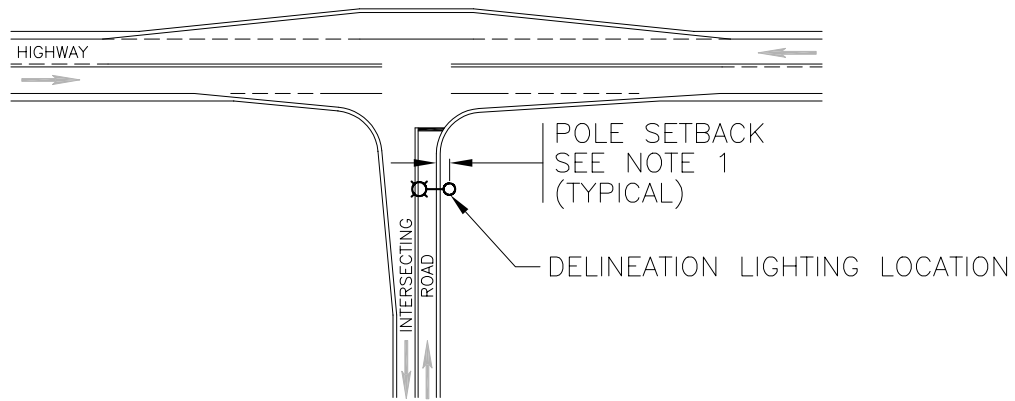
ALTERNATIVE POLE LOCATIONS ON
OUTSIDE OF CURVE: POLES MUST BE
POSITIONED OUTSIDE OVERRUN AREAS



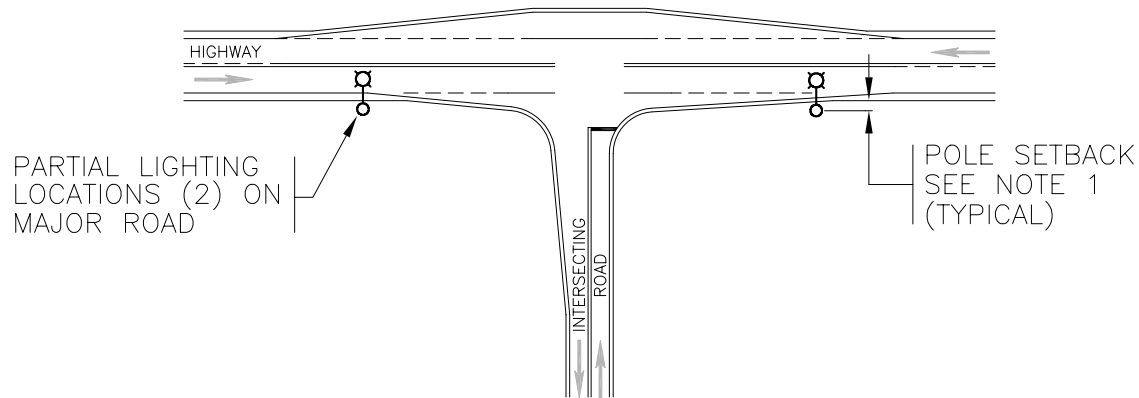
NOTES:

1. POLE SETBACKS TO BE DETERMINED BY APPLICATION OF SECTION E5.3.1 AND FIGURE 5.1.
2. POLE SETBACKS MAY BE REDUCED FROM THOSE DEFINED IN FIGURE 5.1 IF TRAFFIC BARRIER IS INSTALLED. SEE TABLE 5.6 FOR MODIFIED POLE SETBACK REQUIREMENTS.

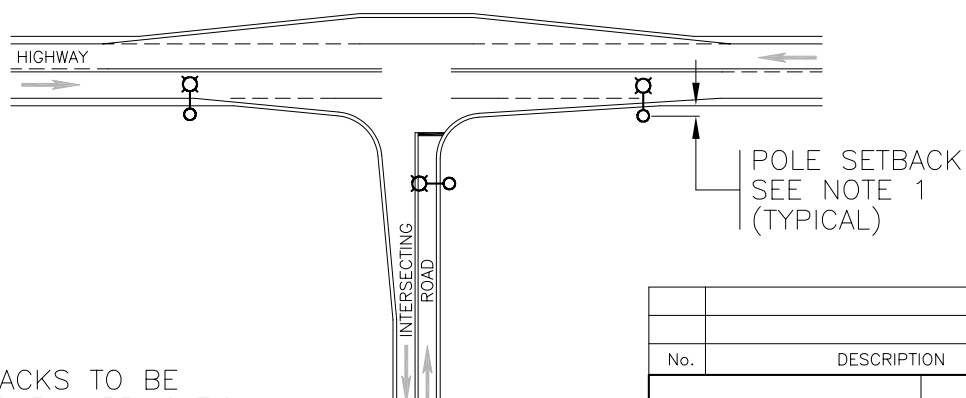
No.	DESCRIPTION	BY	DATE
		DRAWING TCS-E-505	
		Date: MAR 2003	
ROADWAY LIGHTING LOCATION OF POLES ON CURVED ROADS			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E5



DELINEATION LIGHTING
(GENERIC LAYOUT)



PARTIAL LIGHTING
(GENERIC LAYOUT)




FULL LIGHTING
(GENERIC LAYOUT)

NOTES:

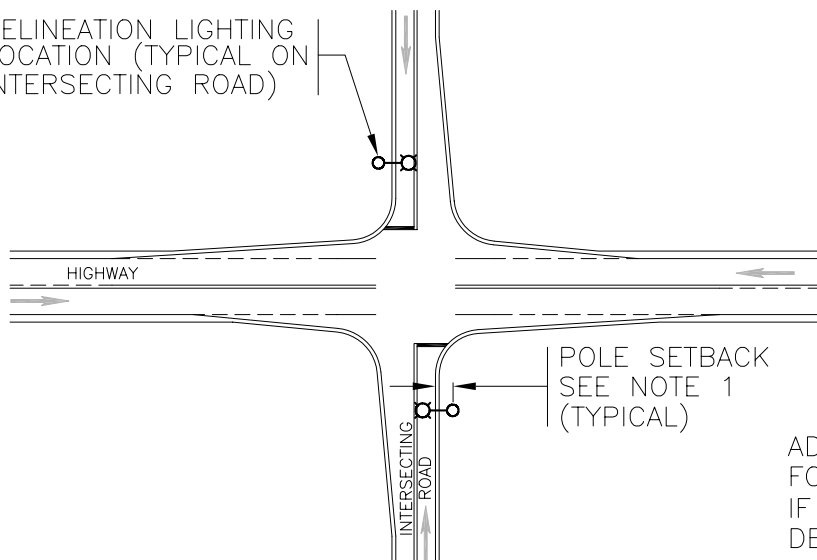
1. POLE SETBACKS TO BE DETERMINED BY APPLICATION OF SECTION E5.3.1 AND FIGURE 5.1.
2. DESIGN LIGHTING LEVELS PER TABLE 5.1.
3. LIGHTING DESIGNER SHALL CONFIRM ALL POLE LOCATIONS BY CALCULATION AND ADJUST FINAL POLE POSITIONS ACCORDINGLY.

DIMENSIONS ARE MILLIMETRES
UNLESS OTHERWISE NOTED



No.	DESCRIPTION	BY	DATE
		DRAWING TCS-E-510.1	
		Date: MAR 2003	
ROADWAY LIGHTING TYPICAL 'T' INTERSECTION DAVIT LUMINAIRE POLE LAYOUT (TWO-LANE HIGHWAY)			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E5

DELINEATION LIGHTING
LOCATION (TYPICAL ON
INTERSECTING ROAD)

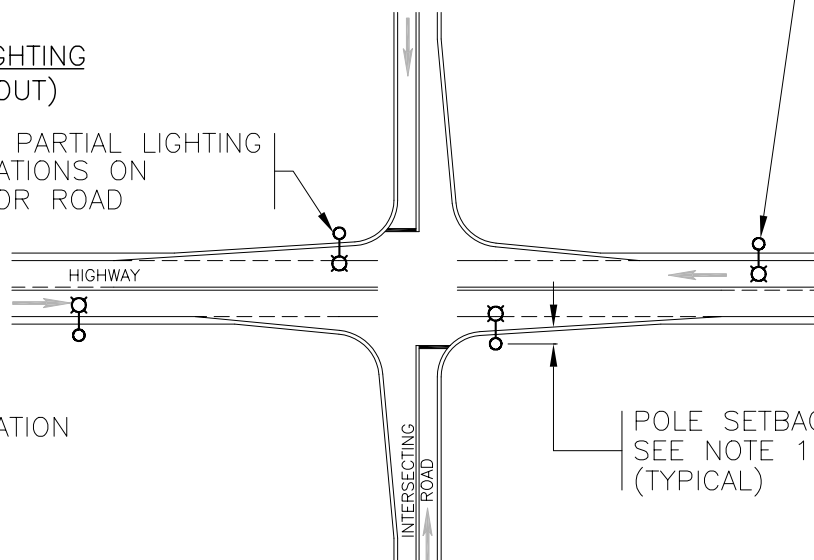


POLE SETBACK
SEE NOTE 1
(TYPICAL)

ADDITIONAL TWO POLES
FOR EXTENDED LIGHTING
IF REQUIRED. LOCATIONS
DETERMINED BY CALCULATION

DELINEATION LIGHTING (GENERIC LAYOUT)

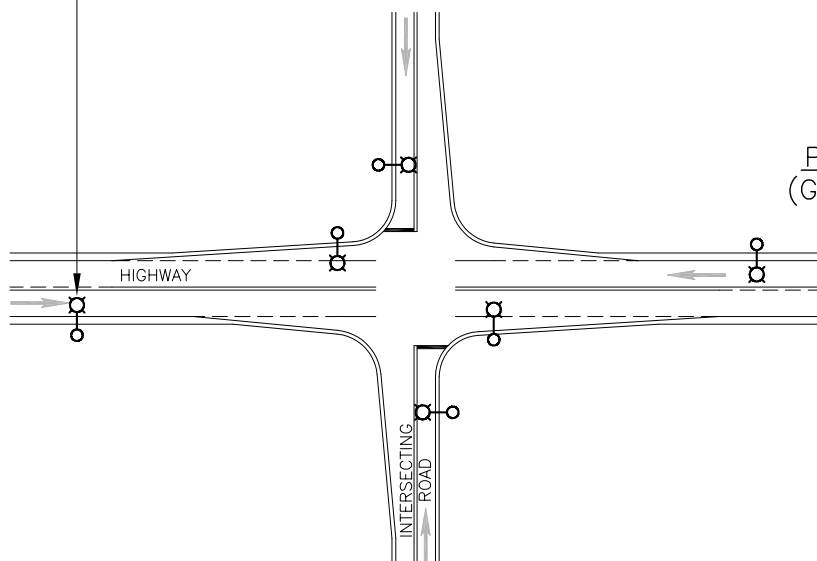
TWO PARTIAL LIGHTING
LOCATIONS ON
MAJOR ROAD



ADDITIONAL TWO POLES
FOR EXTENDED LIGHTING
IF REQUIRED. LOCATIONS
DETERMINED BY CALCULATION

POLE SETBACK
SEE NOTE 1
(TYPICAL)

PARTIAL LIGHTING (GENERIC LAYOUT)




FULL LIGHTING (GENERIC LAYOUT)

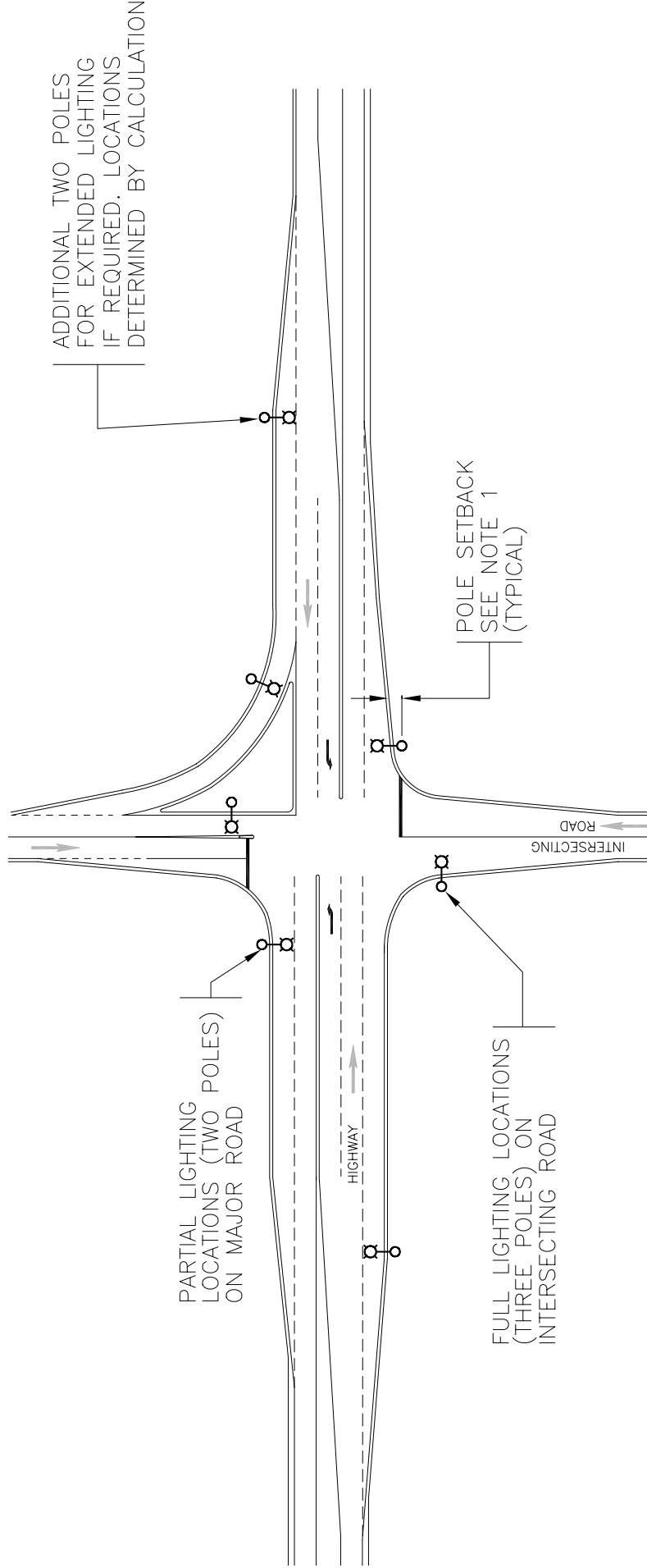
NOTES:

1. POLE SETBACKS TO BE DETERMINED BY APPLICATION OF SECTION E5.3.1 AND FIGURE 5.1.
2. DESIGN LIGHTING LEVELS PER TABLE 5.1.
3. LIGHTING DESIGNER SHALL CONFIRM ALL POLE LOCATIONS BY CALCULATION AND ADJUST FINAL POLE POSITIONS ACCORDINGLY.

DIMENSIONS ARE MILLIMETRES
UNLESS OTHERWISE NOTED



No.	DESCRIPTION	BY	DATE
		DRAWING TCS-E-510.2	
		Date: MAR 2003	
ROADWAY LIGHTING TYPICAL INTERSECTION DAVIT LUMINAIRE POLE LAYOUT (TWO-LANE HIGHWAY)			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E5

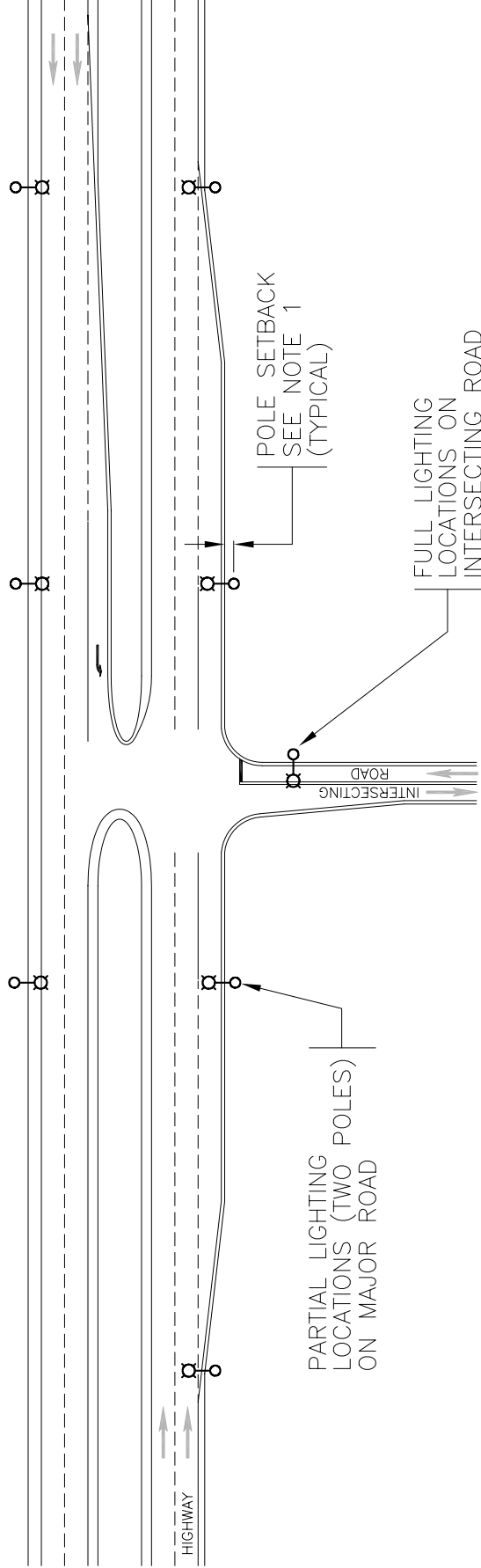


NOTES:

1. POLE SETBACKS TO BE DETERMINED BY APPLICATION OF SECTION E5.3.1 AND FIGURE 5.1.
2. DESIGN LIGHTING LEVELS PER TABLE 5.1.
3. LIGHTING DESIGNER SHALL CONFIRM ALL POLE LOCATIONS BY CALCULATION AND ADJUST FINAL POLE POSITIONS ACCORDINGLY.

PARTIAL LIGHTING
(GENERIC LAYOUT)


No.	DESCRIPTION	BY	DATE
		DRAWING TCS-E-510.3	
		Date:	MAR 2003
ROADWAY LIGHTING TYPICAL CHANNELIZED INTERSECTION DAVIT LUMINAIRE POLE LAYOUT (TWO-LANE HIGHWAY)			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E5

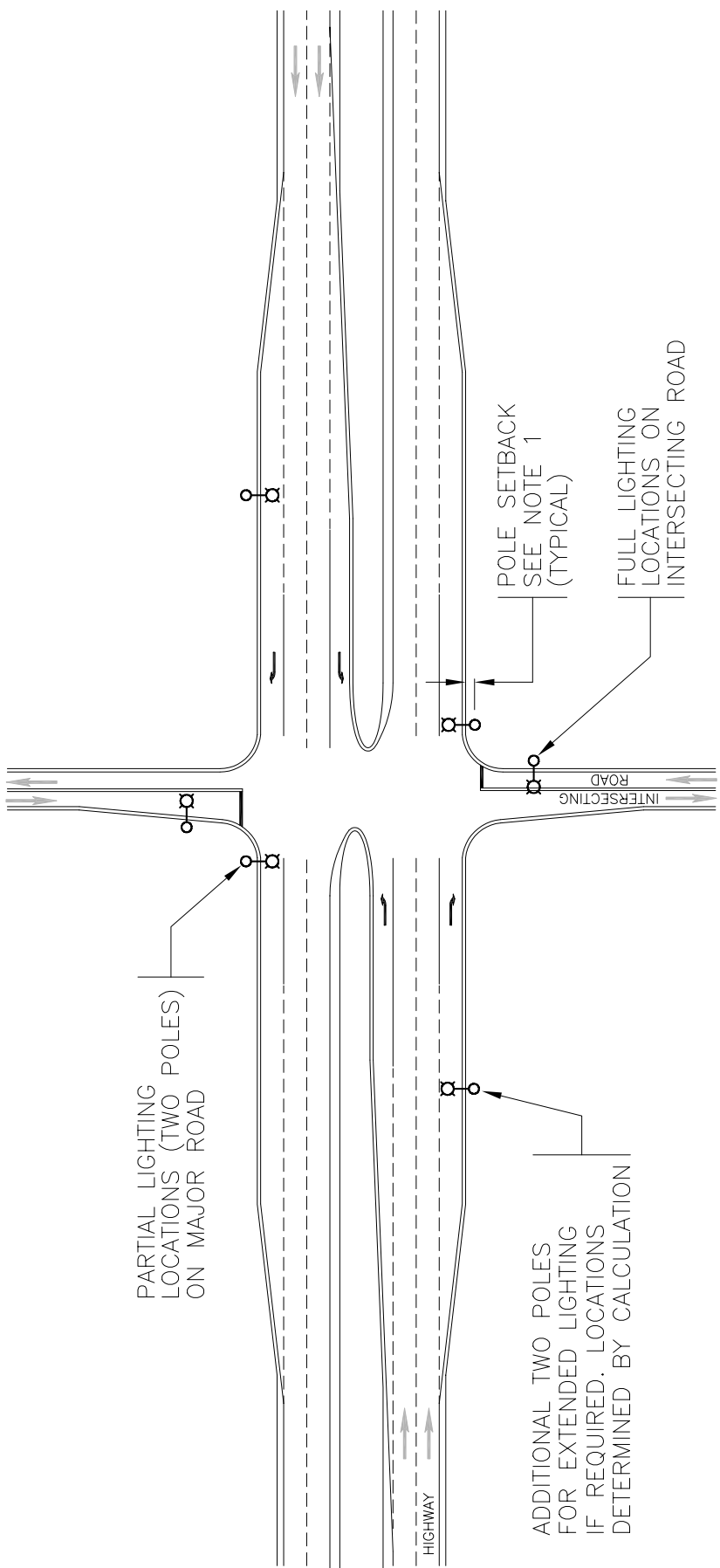


NOTES:

1. POLE SETBACKS TO BE DETERMINED BY APPLICATION OF SECTION E5.3.1 AND FIGURE 5.1.
2. DESIGN LIGHTING LEVELS PER TABLE 5.1.
3. LIGHTING DESIGNER SHALL CONFIRM ALL POLE LOCATIONS BY CALCULATION AND ADJUST FINAL POLE POSITIONS ACCORDINGLY.

PARTIAL LIGHTING
(GENERIC LAYOUT)

No.	DESCRIPTION		BY	DATE	
			DRAWING TCS-E-510.4		
			Date: MAR 2003		
ROADWAY LIGHTING TYPICAL 'T' INTERSECTION DAVIT LUMINAIRE POLE LAYOUT (FOUR-LANE DIVIDED HIGHWAY)					
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E5		




NOTES:

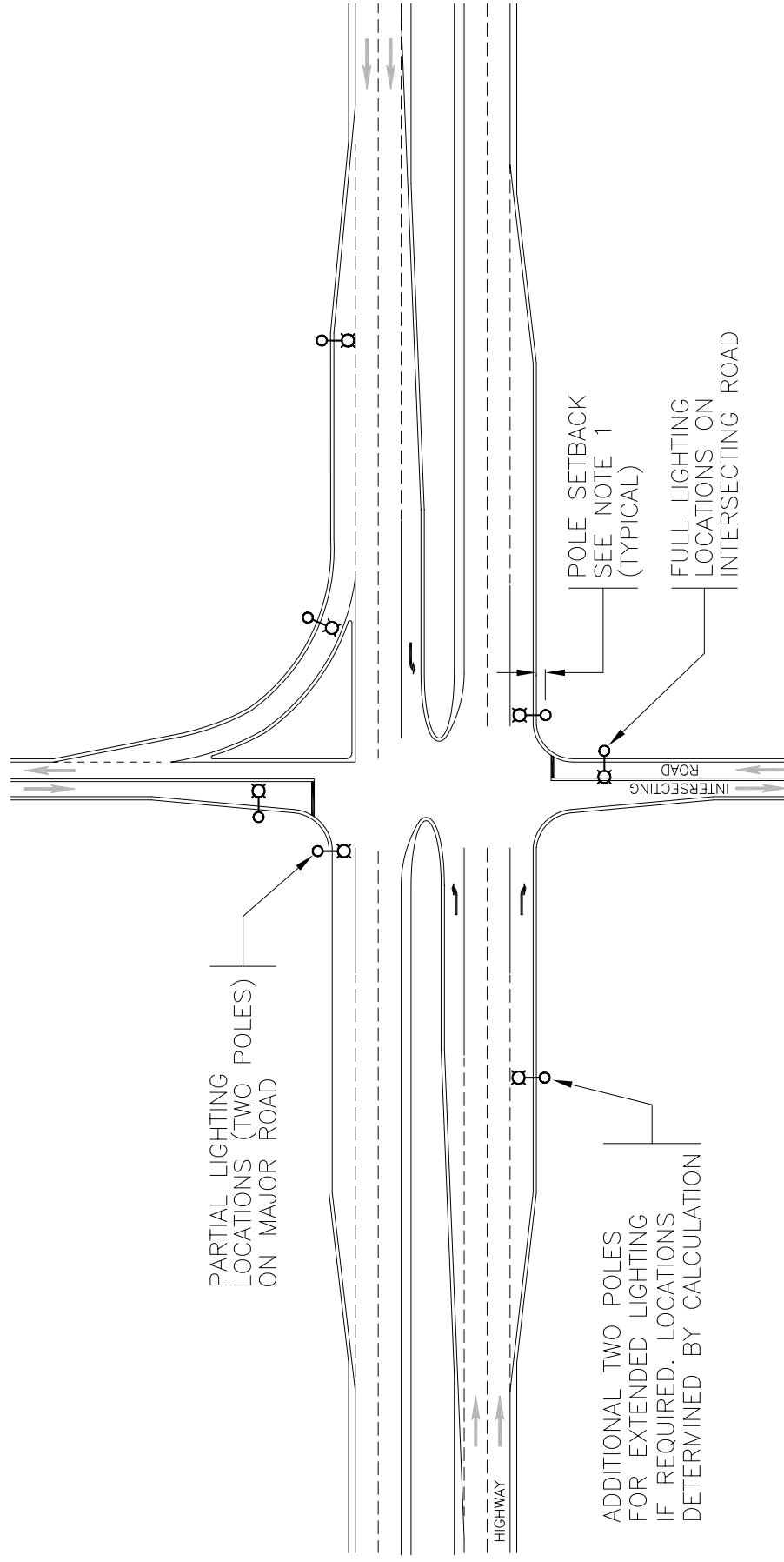
1. POLE SETBACKS TO BE DETERMINED BY APPLICATION OF SECTION E5.3.1 AND FIGURE 5.1.

2. DESIGN LIGHTING LEVELS PER TABLE 5.1.

3. LIGHTING DESIGNER SHALL CONFIRM ALL POLE LOCATIONS BY CALCULATION AND ADJUST FINAL POLE POSITIONS ACCORDINGLY.


PARTIAL LIGHTING
(GENERIC LAYOUT)

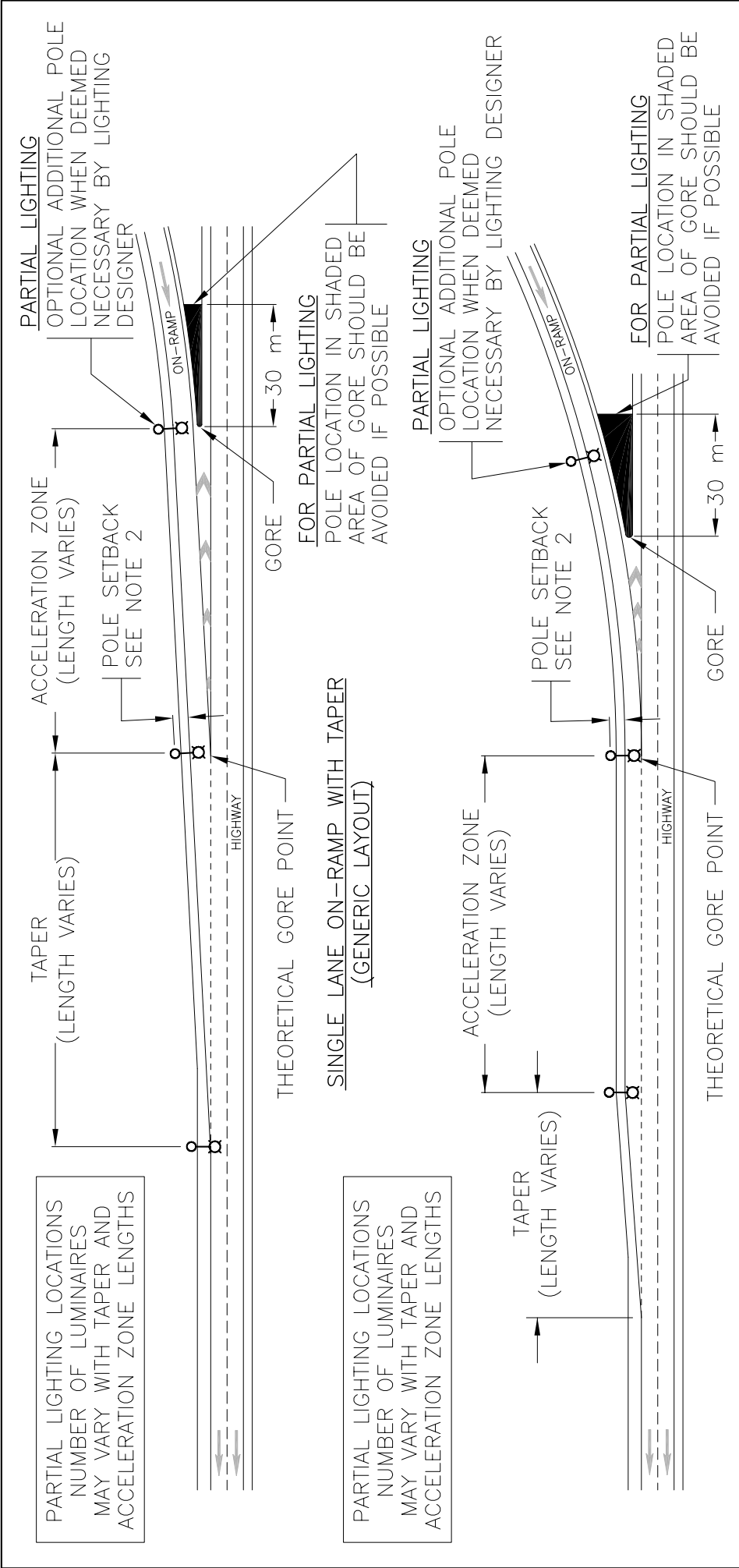
No.	DESCRIPTION	BY	DATE		
		DRAWING TCS-E-510.5		Date: MAR 2003	
ROADWAY LIGHTING TYPICAL INTERSECTION DAVIT LUMINAIRE POLE LAYOUT (FOUR-LANE DIVIDED HIGHWAY)					
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E5		



PARTIAL LIGHTING
(GENERIC LAYOUT)


- NOTES:
1. POLE SETBACKS TO BE DETERMINED BY APPLICATION OF SECTION E5.3.1 AND FIGURE 5.1.
 2. DESIGN LIGHTING LEVELS PER TABLE 5.1.
 3. LIGHTING DESIGNER SHALL CONFIRM ALL POLE LOCATIONS BY CALCULATION AND ADJUST FINAL POLE POSITIONS ACCORDINGLY.

No.	DESCRIPTION	BY	DATE
	 <div style="text-align: right;"> DRAWING TCS-E-510.6 </div>		
		Date:	MAR 2003
	ROADWAY LIGHTING TYPICAL CHANNELIZED INTERSECTION DAVIT LUMINAIRE POLE LAYOUT (FOUR-LANE DIVIDED HIGHWAY)		SECTION E5
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	



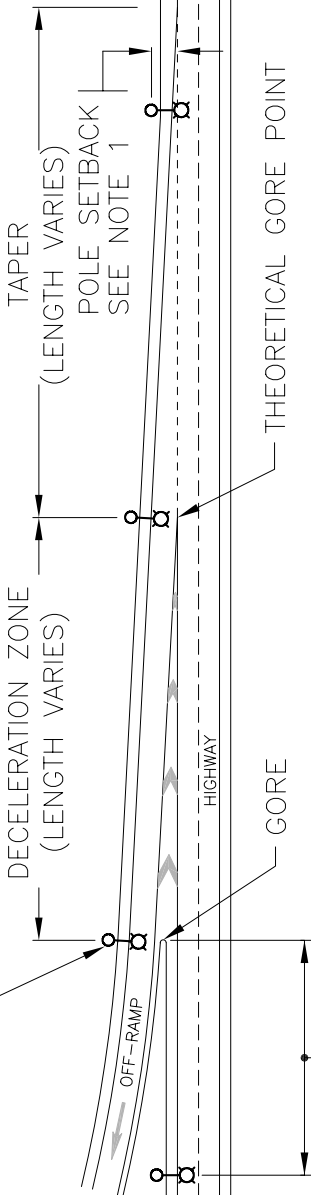
NOTES:
PARALLEL ON-RAMP ACCELERATION LANE
(GENERIC LAYOUT)

1. POLE SETBACKS TO BE DETERMINED BY APPLICATION OF SECTION E5.3.1 AND FIGURE 5.1.
2. DESIGN LIGHTING LEVELS PER TABLE 5.1.
3. LIGHTING DESIGNER SHALL CONFIRM ALL POLE LOCATIONS BY CALCULATION AND ADJUST FINAL POLE POSITIONS ACCORDINGLY.

No.	DESCRIPTION		BY	DATE
			DRAWING TCS-E-515.2	
			Date: MAR 2003	
ROADWAY LIGHTING TYPICAL ON-RAMP DAVIT LUMINAIRE POLE LAYOUTS				
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E5	

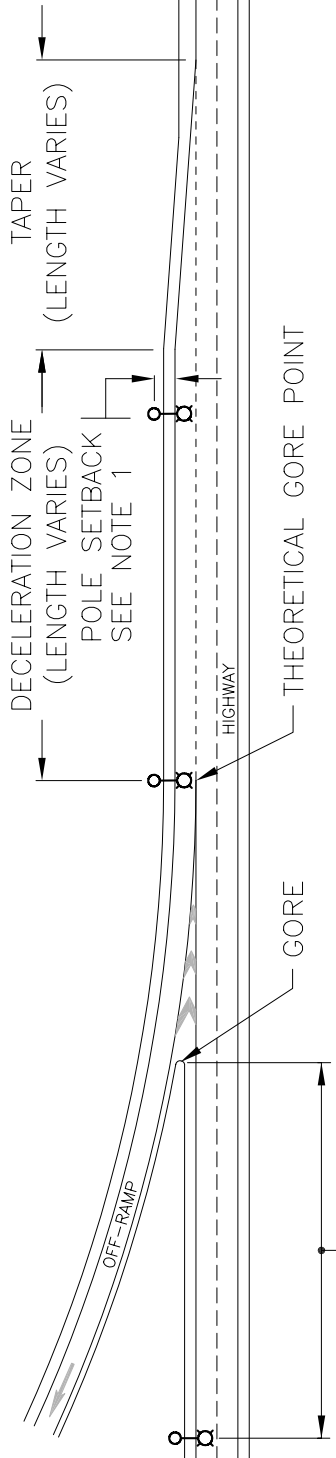
PARTIAL LIGHTING

OPTIONAL ADDITIONAL POLE LOCATION
WHEN DEEMED NECESSARY BY LIGHTING DESIGNER
(IF OBJECT IS LOCATED IN GORE AREA)



SEE DRAWING TCS-E-515.4
FOR POLE LOCATION WITH
RESPECT TO GORE

**SINGLE LANE OFF-RAMP WITH TAPER
(GENERIC LAYOUT)**




SEE DRAWING TCS-E-515.4
FOR POLE LOCATION WITH
RESPECT TO GORE

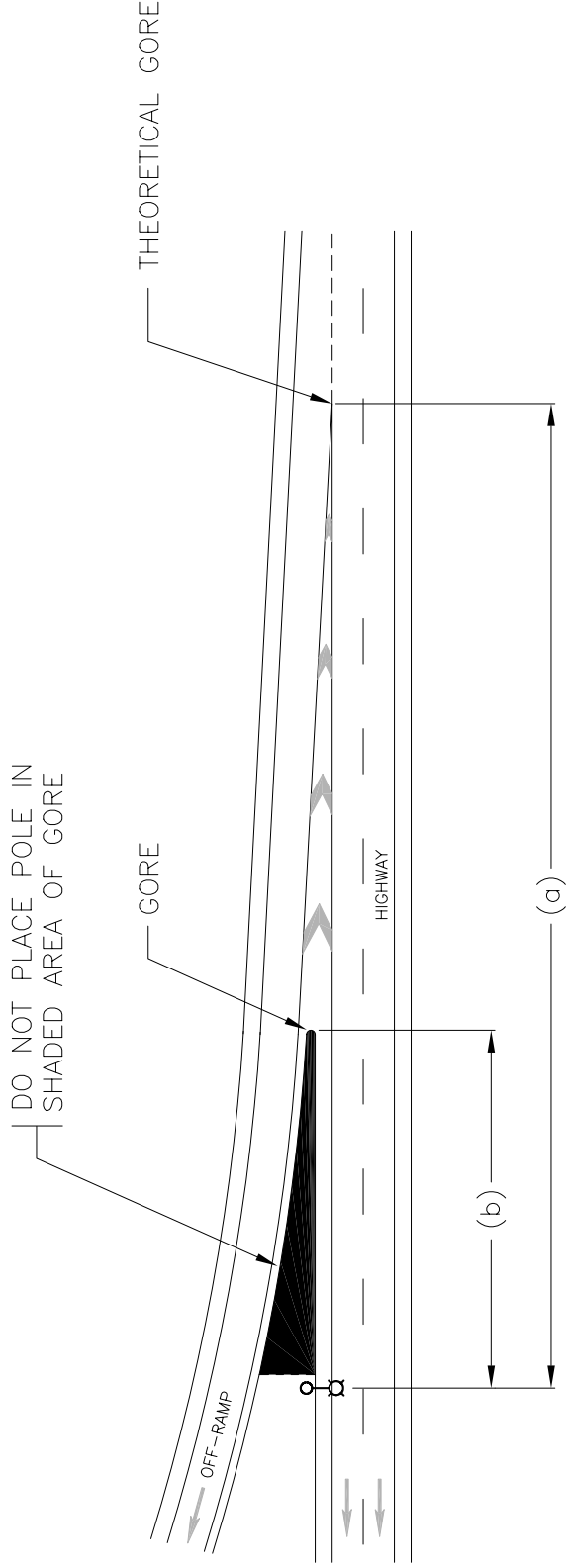
**PARALLEL OFF-RAMP DECELERATION LANE
(GENERIC LAYOUT)**

NOTES:

1. POLE SETBACKS TO BE DETERMINED BY APPLICATION OF SECTION E5.3.1 AND FIGURE 5.1.
2. DESIGN LIGHTING LEVELS PER TABLE 5.1.
3. LIGHTING DESIGNER SHALL CONFIRM ALL POLE LOCATIONS BY CALCULATION AND ADJUST FINAL POLE POSITIONS ACCORDINGLY.

No.	DESCRIPTION	BY	DATE
		DRAWING TCS-E-515.3	
		Date:	MAR 2003
ROADWAY LIGHTING TYPICAL OFF-RAMP DAVIT LUMINAIRE POLE LAYOUTS			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E5





POLE LOCATION IN GORE AREA

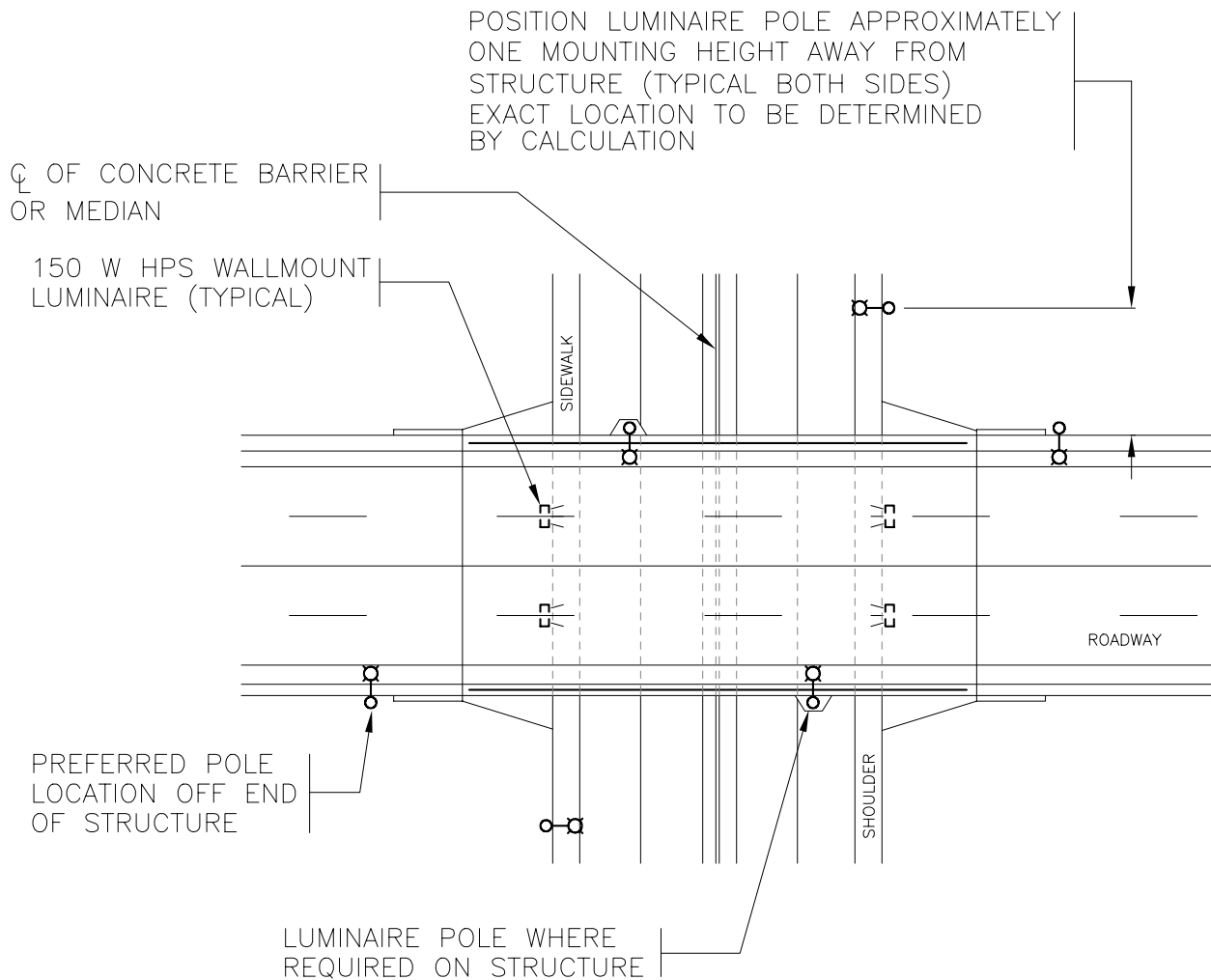
HIGHWAY DESIGN SPEED km/h	(a) m
60	85
70	95
80	105
90	125
100	145
110	185

HIGHWAY DESIGN SPEED km/h	(b) m
>80	45
≤80	30

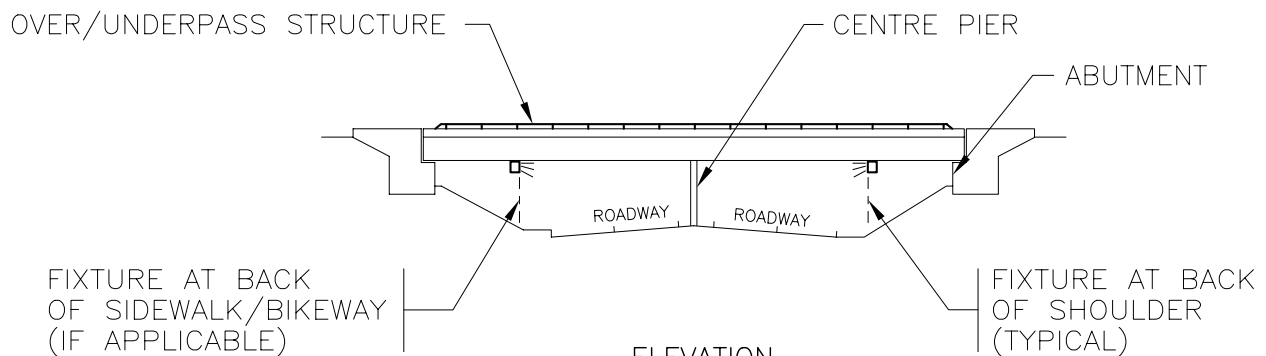
NOTES:

- BOTH (a) AND (b) MINIMUM CLEARANCES MUST BE MET.
- WHERE DESIGN SPEED IS NOT AVAILABLE USE POSTED SPEED.

No.	DESCRIPTION	BY	DATE
		DRAWING TCS-E-515.4	
		Date: MAR 2003	
ROADWAY LIGHTING DAVIT LUMINAIRE POLE LOCATION IN GORE AREA			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E5



PLAN




ELEVATION

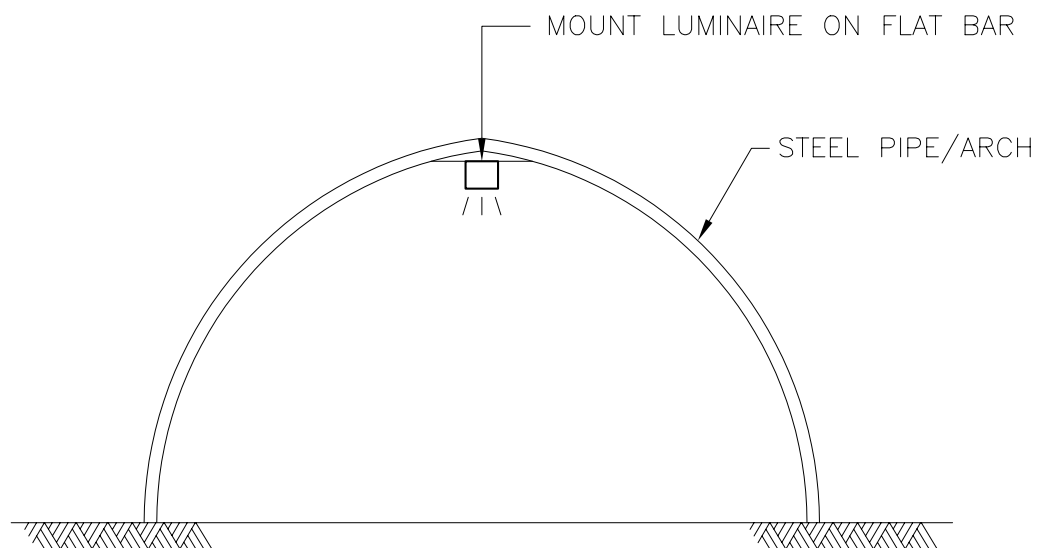
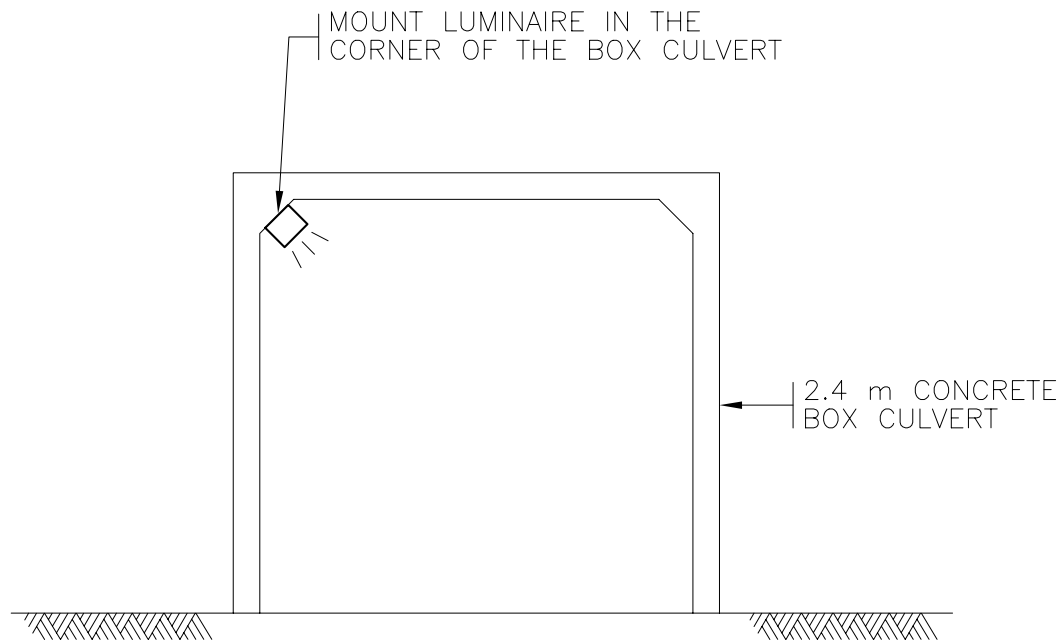
NOTES:


1. POLE SETBACKS TO BE DETERMINED BY APPLICATION OF SECTION E5.3.1 AND FIGURE 5.1.
2. DESIGN LIGHTING LEVELS PER TABLE 5.1.
3. LIGHTING DESIGNER SHALL CONFIRM ALL POLE LOCATIONS BY CALCULATION AND ADJUST FINAL POLE POSITIONS ACCORDINGLY.

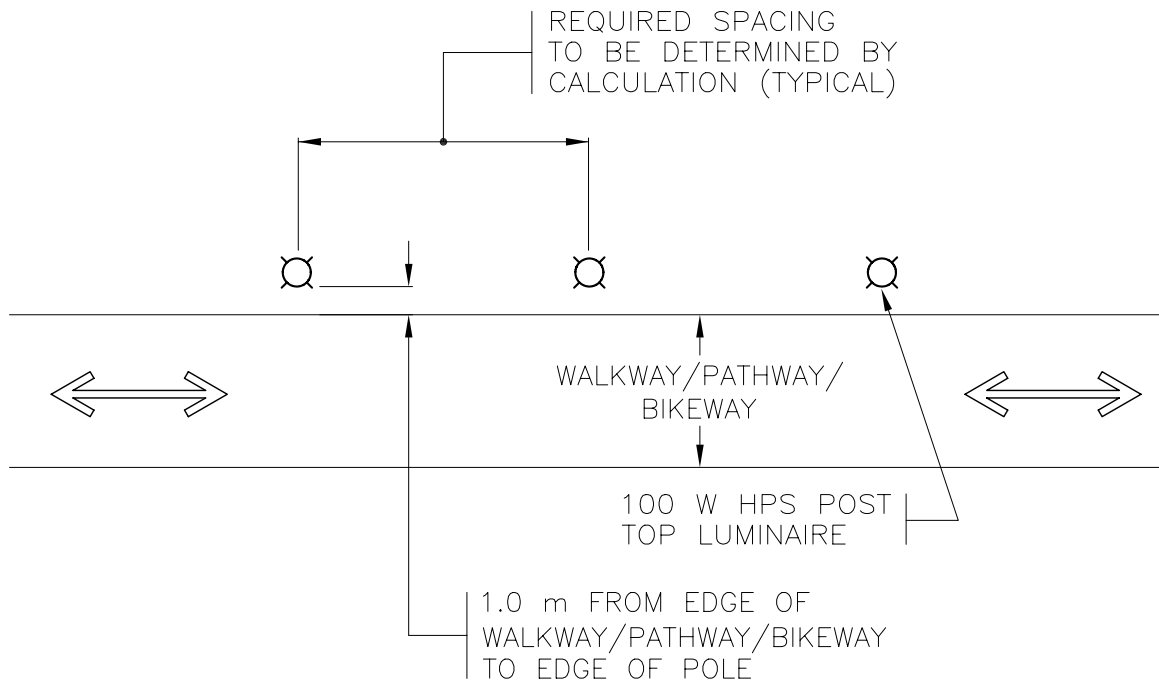
DIMENSIONS ARE MILLIMETRES
UNLESS OTHERWISE NOTED



No.	DESCRIPTION	BY	DATE
		<div>DRAWING TCS-E-515.5</div> <div>Date: MAR 2003</div>	
ROADWAY LIGHTING TYPICAL UNDERPASS/OVERPASS LIGHT FIXTURE LOCATIONS			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E5




No.	DESCRIPTION	BY	DATE
		DRAWING TCS-E-520	
		Date:	MAR 2003
ROADWAY LIGHTING TYPICAL PEDESTRIAN AND BICYCLE TUNNEL LIGHT FIXTURE LOCATIONS			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E5

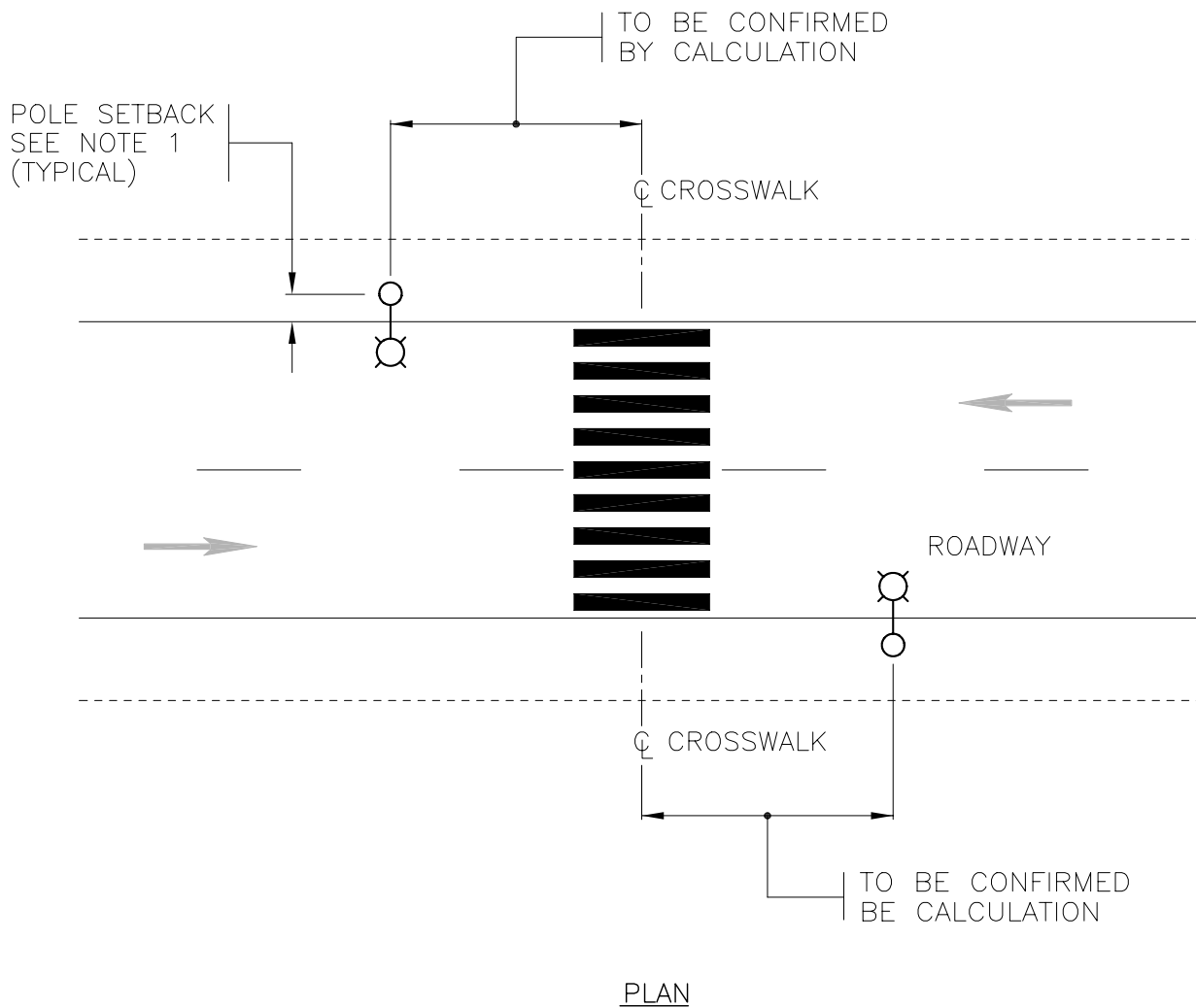


PLAN

NOTES:


1. DESIGN LIGHTING LEVELS TO MEET THE REQUIREMENTS OF TABLE 5.9.
2. TYPICAL LAYOUT FOR POST TOP LUMINAIRES (TYPE 3 OR TYPE 5 DISTRIBUTION).

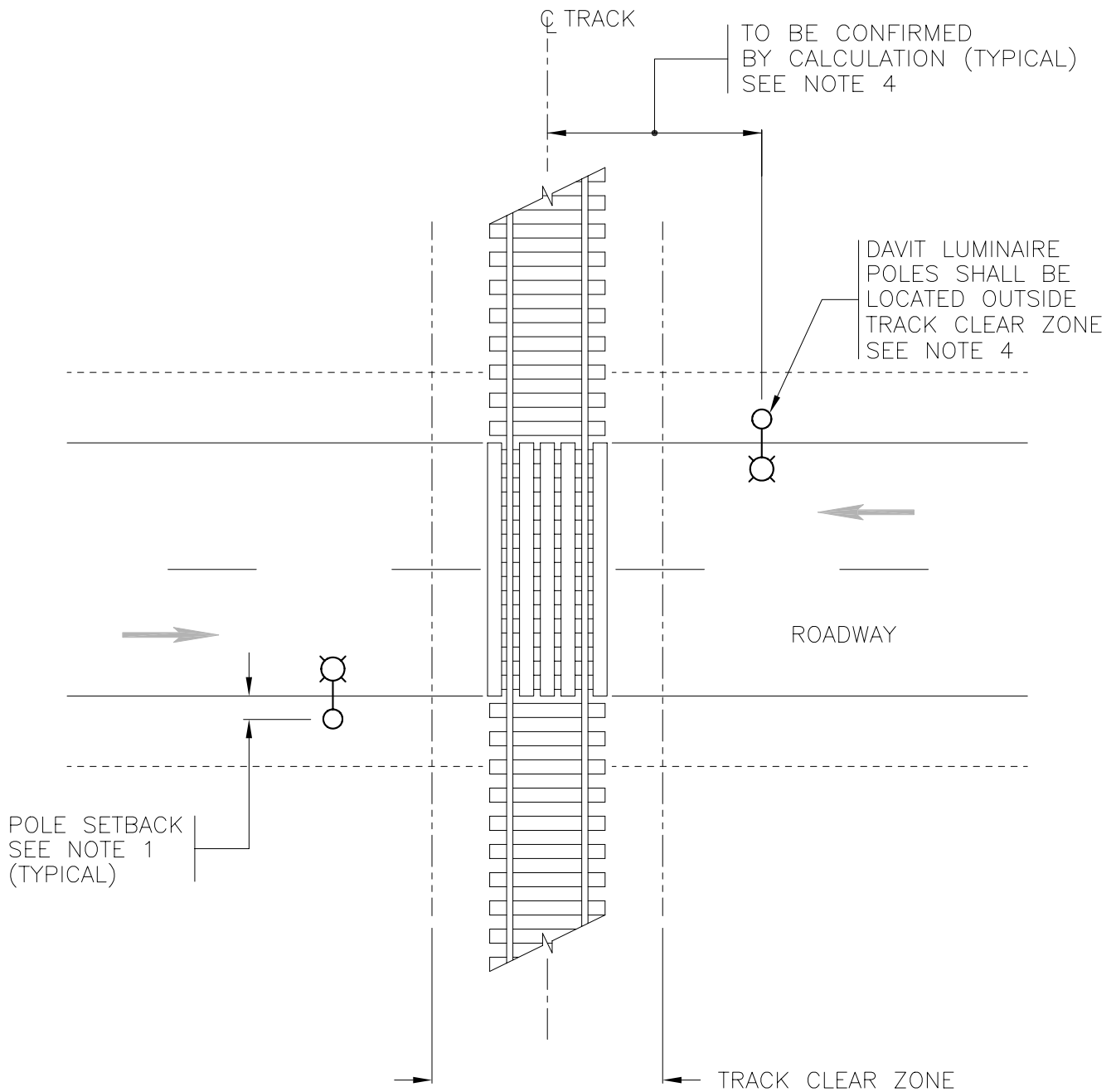
No.	DESCRIPTION	BY	DATE
		DRAWING TCS-E-525	
		Date: MAR 2003	
ROADWAY LIGHTING TYPICAL WALKWAY, PATHWAY, BIKEWAY LUMINAIRE POLE LAYOUT			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E5



NOTES:

1. THIS POLE CONFIGURATION IS FOR NON-INTERSECTION LOCATED PEDESTRIAN CROSSWALKS.
2. POLE SETBACKS TO BE DETERMINED BY APPLICATION OF SECTION E5.3.1 AND FIGURE 5.1.
3. DESIGN LIGHTING LEVELS PER TABLE 5.1.
4. LIGHTING DESIGNER SHALL CONFIRM ALL POLE LOCATIONS BY CALCULATION AND ADJUST FINAL POLE POSITIONS ACCORDINGLY.


No.	DESCRIPTION	BY	DATE
		DRAWING TCS-E-530	
		Date: MAR 2003	
ROADWAY LIGHTING TYPICAL PEDESTRIAN CROSSING DAVIT LUMINAIRE POLE LAYOUT			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E5

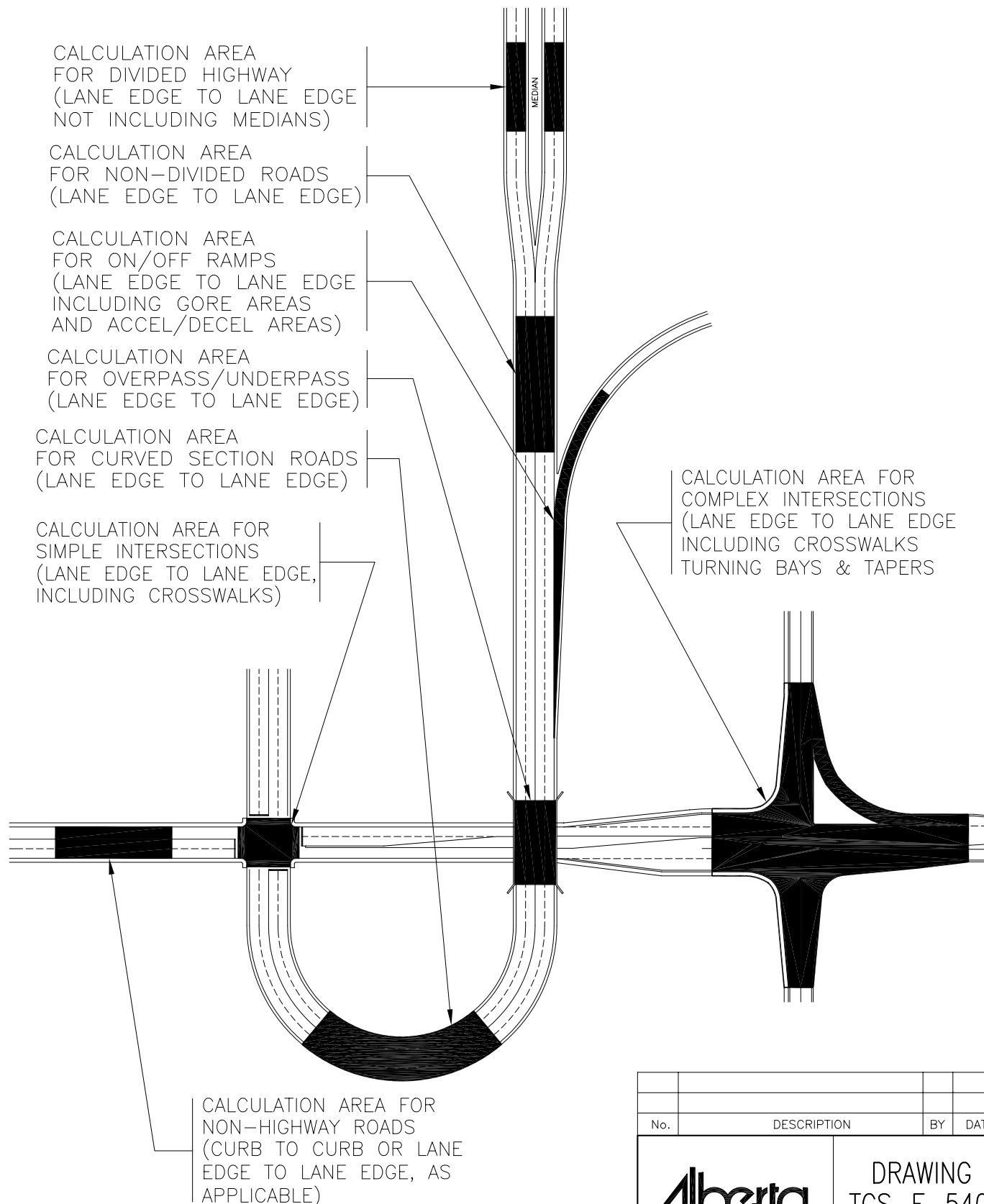


PLAN

NOTES:

1. POLE SETBACKS TO BE DETERMINED BY APPLICATION OF SECTION E5.3.1 AND FIGURE 5.1.
2. DESIGN LIGHTING LEVELS PER TABLE 5.1.
3. LIGHTING DESIGNER SHALL CONFIRM ALL POLE LOCATIONS BY CALCULATION AND ADJUST FINAL POLE POSITIONS ACCORDINGLY.
4. IF POLE IS LOCATED WITHIN RAILWAY RIGHT-OF-WAY, APPROVAL MUST BE OBTAINED FROM RAILWAY OWNER.

No.	DESCRIPTION	BY	DATE
		DRAWING TCS-E-535	
		Date:	MAR 2003
ROADWAY LIGHTING TYPICAL AT-GRADE RAILWAY CROSSING DAVIT LUMINAIRE POLE LAYOUT			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E5




NOTE:

1. FOR FURTHER CLARIFICATION OF LIGHT CALCULATION GRID DEFINITION REFER TO TABLE 5.4.

DIMENSIONS ARE MILLIMETRES
UNLESS OTHERWISE NOTED



No.	DESCRIPTION	BY	DATE
		DRAWING TCS-E-540	
		Date: MAR 2003	
ROADWAY LIGHTING ILLUMINATION CALCULATION AREAS			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E5

E6 LIGHTING COMPONENTS

E6.1 Canadian Electrical Code

Roadway lighting components shall be designed in accordance with the Canadian Electrical Code (CEC) Part 1 and Part 2 as applicable.

E6.1.1 Existing Infrastructure

In the case where existing infrastructure is to be relocated or rehabilitated, an assessment of the condition, state and functionality of the system must be performed. If, due to age, wear and tear or alteration, the equipment or wiring has become a hazard, it is required that all such equipment be removed and/or replaced. Any replacements or upgrades must utilize the standards of CEC Part 1 as much as practical.

E6.1.2 Expanding Existing Infrastructure

In the case where new construction will expand an existing adjacent lighting system, an assessment of the condition, state and functionality of the combined system must be performed. The lighting designer shall determine the suitability, condition and capacity of the existing wiring, distribution equipment and loads for expansion.

The lighting designer must evaluate the existing system, its compatibility with the expanded system, and provide recommendations with capital cost and life cycle estimates for providing the new lighting system on its own and in combination with bringing the existing lighting system up to current standards.

In some cases it may not be practical or economically desirable to upgrade the remaining system to comply with CEC Part 1.

However, full consideration should be given to upgrading the system should it be in the long-term interest to have this carried out.

E6.1.3 New Infrastructure

All new infrastructure must comply with CEC Part 1. This includes the provision in the design for an electrical disconnect and meter, to properly delineate ownership of the electrical system between Alberta Transportation and the local Wire Service Provider (WSP).

E6.2 Standard Lighting Components

A limited number of roadway lighting components have been approved as a standard for any new construction projects. Projects that include additions or revisions to existing roadway lighting systems must address any need for matching to existing components for overall design, operational and aesthetic reasons. The lighting designer shall determine the best method to add to or revise the existing lighting system to allow for the best integration with adjacent lighting.

E6.2.1 Existing Standard Components

The existing roadway lighting components in place today are comprised of a variety of models and styles provided over the years by the various electric utilities. Each utility has adopted standard cabling, bases, poles and luminaires to effectively manage the stocking and supply costs of materials. The approved list of materials includes some of these and standardized on others as a best compromise from previous standards.

E6.2.2 Bases

There are three acceptable standard types of pole bases: the cast-in-place concrete base, the

precast concrete base and the steel screw-in-anchor base. Each type has a recommended use within certain parameters and the lighting designer shall determine which base shall be used for each particular project. Specialty bases, such as bases that form an integral part of a bridge, require individual engineering design to address items such as pole size, loading and anchor bolt arrangement. Table 6.1 lists the base selection in a variety of soil conditions.

E6.2.2.1 Cast-in-place Base

The cast-in-place concrete base has historically been a more stable base in withstanding pole leaning over time. However, quality issues must be effectively managed if this base is specified for a project. These issues may include (but are not limited to):

- The availability of concrete. The distance of delivery from a supply source affects the delivery temperature of the concrete, which in turn affects slump and quality.
- The ambient temperature for the installation day as well as during the curing period.
- The practicality for a minimum curing period before placement of the pole and remobilization of construction crews within the project timelines. Note that this also affects the overall time that contractors are present at the site and near traffic. This is a potential safety concern.
- The availability for inspection to ensure quality. Installation procedures that require particular consideration include reinforcing cage placement, top of base elevation control, and alignment and placement of the anchor bolts.
- Aesthetics within urban centres may also be an issue as the cast-in-place concrete base tends to have a rough overall finish.

The top of the cast-in-place base shall be 100 mm (with a tolerance of 50 mm) higher in elevation than the compacted grade after landscaping surrounding the base. On a slope, this refers to the highest grade in the uphill direction. The top section of concrete tubing surrounding the base must be removed to below grade (out of sight). The viewable top portion of the base must be well finished aesthetically and with a 2% slope to allow drainage of water away from the anchor bolts. The cast-in-place base shown in Drawing TCS-E-601.1 is suitable for any pole with a 330 mm BCD up to and including a 15 m double davit pole located in a non-fill area and with a slope flatter than or equal to 5:1.

All other situations, such as fill areas on slopes steeper than 5:1 or poles exceeding 15 m in height, shall have a cast-in-place base specifically engineered and signed by a professional engineer registered to practice in Alberta.

E6.2.2.2 Precast Base

The precast concrete base effectively addresses all the concerns listed for cast-in-place bases and is a common industry standard for roadway lighting pole bases. The backfill for a precast base shall be compacted to a minimum 95% Modified Proctor Density (MPD) for the full excavation. Backfill material shall be native material and shall not include ice, snow, sharp objects, organic material or silty soil. If insufficient acceptable native material is available, then clay backfill material must be brought in as required. Third party testing may be required as determined by the lighting designer and/or project geotechnical engineer.

The top of the precast base shall be 100 mm (with a tolerance of 50 mm) higher in elevation than the compacted grade after landscaping surrounding the base. On a slope, this refers to the highest grade in the uphill direction. The precast base shown in

Drawing TCS-E-601.2 is suitable for any pole with a 330 mm BCD up to and including a 15 m double davit pole located in a non-fill area and with a slope flatter than or equal to 5:1.

All other situations, such as fill areas on slopes steeper than 5:1 or poles exceeding 15 m in height, shall have a cast-in-place base specifically engineered and signed by a professional engineer registered to practice in Alberta.

E6.2.2.3 Steel Screw-in Base

Steel screw-in-anchor bases also effectively address all the concerns listed for cast in place bases as well as the backfill compaction issue listed for precast bases. The steel anchor must include welded "flights" to withstand frost heave and prevent pole leaning. However, the anchor requires a substantial torque to install that must be addressed by the availability of appropriate installation equipment. The lighting contractor must also be experienced in installing this type of anchor. It must be installed at a rate defined by the "flight" pitch. An error in installation may result in disturbed surrounding soil similar to a stripped screw rather than a secure fit.

The advantages of specifying the steel anchor base include lower installation cost and the ability to avoid installing an extra ground wire or a separate ground rod.

The top of the steel screw-in-anchor base plate shall be 100 mm (with a tolerance of 50 mm) higher in elevation than the grade after landscaping surrounding the base. On a slope, this refers to the highest grade in the uphill direction. The steel screw-in-anchor base plate shall also be of sufficient dimensions to match the specified pole height and be predrilled or slotted to match the pole's Bolt Circle Diameter (BCD) and bolt size.

The steel screw-in-anchor shown in Drawing TCS-E-601.3 is suitable for any pole up to and including a 15 m double davit pole located in a non-fill area and with a slope of less than or equal to 5:1.

All other situations, such as fill areas on slopes steeper than 5:1 or poles exceeding 15 m in height, shall have a cast-in-place base specifically engineered and signed by a professional engineer registered to practice in Alberta.

TABLE 6.1 - BASE SELECTION

Pole Base Location	Cast-in-place Concrete Base	Precast Concrete Base	Steel Screw-in Anchor Base
Clay based soil	PREFERRED	SUITABLE	SUITABLE
Cohesionless based soil (gravel, sand)	SUITABLE	PREFERRED	NOT SUITABLE
Extreme frost concern locations	SUITABLE	SUITABLE	SUITABLE
Pole base locations within urban areas	SUITABLE	SUITABLE	SUITABLE

E6.2.2.4 Break-away Bases

Break-away (B/W) bases shall be used to meet the requirements of Figure 5.1 and to allow for maintenance access.

The lighting contractor shall ensure that the specified B/W base is suitable for the intended use including matching the pole Bolt Circle Diameter (BCD), the anchor bolt size, length and taper. Lighting contractor must

provide the base manufacturer with the BCD to allow a match to the reaction plate. Two approved B/W bases are the "Manitoba Safety Base" and the "Transpo" base. Any proposed addition to the approved suppliers for break-away bases shall follow the procedure listed in Section E2.3.4.

B/W bases shall not be used for high mast poles. The use of a break-away base assembly is preferred in all areas where there is sufficient room for the pole to fall away in the event of a collision. See Section E5.3.1.1.

E6.2.3 Poles (General Provisions)

Table 6.2 lists the typical pole height and luminaire combinations for most new roadway lighting projects. However, many other pole types, sizes and finishes exist in the

field and adjustments to Table 6.2 may be made for reasons such as:

- Matching to existing infrastructure.
- Meeting various desired requirements within urban centres such as decorative lighting installations.

Addressing severe clearance restrictions near overhead power lines, near airports or on structures (bridges or traffic signal poles).

Pole specifications are provided in Section 2.25 of the Alberta Transportation Standard Specification for Highway Construction. These specifications stipulate minimum design criteria from a structural and manufacturing perspective.

TABLE 6.2 - TYPICAL POLE AND LUMINAIRE COMBINATIONS

Lamp Wattage and Type	Line Current (A) at 240 V	Luminaire Type	Luminaire Refractor Type	Standard Luminaire Mounting Height	IESNA Luminaire Distribution Types
250 W HPS (clear)	1.3	Cobra head	Standard Sag Glass	13.0 m	Type 2 or 3, medium semi-cutoff
250 W HPS (clear)	1.3	Cobra head	Flat Glass	13.0 m	Type 2 or 3, cutoff
400 W HPS (clear)	1.9	Cobra head	Standard Sag Glass	15.0 m	Type 2 or 3, medium semi-cutoff
400 W HPS (clear)	1.9	Cobra head	Flat Glass	15.0 m	Type 2 or 3, cutoff
150 W HPS (coated)	0.8	Wall Mount	Glass	As required on bridge structure	Type 2 or 3
100 W HPS (clear)	0.6	Post Top	Glass	6.0 m	Type 3 or 5
1000 W HPS (clear)	4.8	High mast	Flat or convex glass	30.0 m	Type 4 or 5, cutoff

E6.2.3.1 Davit Poles

There are two standard davit/double davit pole heights. The standard pole heights are 13.0 m and 15.0 m. The length of the davit arm for all poles shall be 2.5 m. The 13.0 m pole is recommended for use in remote areas as taller maintenance equipment may not be as readily available.

Other variances to the davits such as festoon power outlets may be proposed on a case-by-case basis if they do not exceed the pole loading specifications.

E6.2.3.2 Straight Poles

Straight poles shall only be used in the following applications:

- High mast poles with a high mast style luminaire assembly.
- Bridge decks in which vibration is a large concern and the davit arm promotes further wire and luminaire fatigue.
- Walkways and Bikeways, Rest Areas and Vehicle Inspection Stations.

E6.2.3.3 High Mast Poles

High mast poles shall include a raise/lower device. Approved raise/lower devices include Holophane and Concrete Utilities. The intent is not to limit the number of manufactures but to ensure that only a high quality and proven long lasting product will be used. Alberta Transportation must approve any proposed addition to the approved suppliers for high mast raise/lower devices.

The standard high mast pole height is 30 m. The high mast pole shall include a bottom section of suitable diameter to house the winch drive motor and other required apparatus for the raise/lower device. Pole heights greater than 30 m must be justified on a project specific basis.

The cast-in-place base shown in Drawing TCS-E-601.4 is suitable for 30 m high mast poles.

E6.2.3.4 Yielding Poles

Yielding poles shall not be used on Alberta Transportation roadway lighting projects.

E6.2.3.5 Decorative Poles

Decorative poles are only considered in urban areas and must be justified on a project specific basis. Alberta Transportation shall not be responsible for any additional cost associated with the manufacture, installation, maintenance, or operation of a decorative pole.

E6.2.3.6 Reuse of Salvaged Poles

Any poles that are salvaged as a result of a roadway lighting project shall not be reused or relocated unless they are galvanized and in very good condition. The lighting designer and/or Alberta Transportation Operations Manager shall determine which poles are suitable for reuse. Painted poles shall only be reused by special permission from Alberta Transportation.

E6.2.3.7 Pole Finish

All roadway lighting poles shall have a hot dipped galvanized finish. Double dipped long section poles, such as high mast poles, are acceptable. Galvanizing paint may only be used to touch up marks and scratches that may have occurred during transport and assembly. If a project includes an aesthetic requirement for coloured poles, then a factory powder coat finish with the approved colour applied over the galvanized steel pole shall be used. A detailed procedure in obtaining and applying a powder coat touch up to the poles must be provided with the warranty information from the pole manufacturer.

E6.2.4 Pole Hand Holes

Pole hand holes shall be positioned to allow a person working on the internal wiring to face oncoming traffic. It must also be of sufficient size (127 mm x 305 mm) to facilitate splicing of up to three cables (2 conductor #4 copper Teck 90 with ground wire).

E6.2.5 Luminaires

The luminaire houses the ballast, lamp, reflector and all other related components. It shall include matching lamp wattage, lamp voltage and ballast voltage (line and load). It shall also have the correct cutoff classification, ingress protection (IP) rating and lighting distribution type suitable for the proposed use.

E6.2.5.1 Lamp Wattage

There are five approved HPS wattages for roadway lighting: 100 W, 150 W, 250 W, 400 W and 1000 W. The 100 W luminaire is required for walkway and bikeway lighting. The 150 W luminaire is required for tunnel and underpass applications. The 250 W luminaire is primarily intended for the 13 m davit height, the 400 W is primarily intended for the 15 m davit height and the 1000 W is for high mast applications. High mast luminaires shall include a vertically placed lamp to yield the available and superior uniformity of lighting. Cobra head style luminaires shall not be used in high mast applications.

E6.2.5.2 Ballasts

All luminaires shall have a tritap 120/208/240 V ballast. The most commonly available luminaire source (considering voltage drop) is the 240 V option as it is readily offered by all utilities across Alberta. All ballasts shall be CWI to facilitate the 240 V "line" voltage source.

Some projects may benefit greatly from a higher voltage (347/600 V three phase) source, which may also be available at the project location. The benefits of an alternate voltage would have to be justified in the pre-design report and the ready availability of the 347 V ballast must be shown to facilitate future maintenance concerns.

E6.2.5.3 Luminaire Voltage

The ballast output voltage to the different wattage lamps shall be as per the following standard: 100 W and 150 W lamps shall be rated at 55 V and all higher wattages (250 W, 400 W and 1000 W) shall be rated at 100 V.

These lamp voltages shall be used whenever possible. However, certain manufacturers may deviate from this standard. A different lamp voltage may be acceptable by special permission if it can be shown that the

standard will severely limit the potential suppliers of roadway luminaires for a particular project. Special note within the maintenance and warranty documentation for the project must be made if this is the case.

E6.2.5.4 Lamp Quality

The standard for all HPS lamps is the long life, non-cycling lamp. Rated lamp life is generally approximately 25,000 h for standard HPS lamps and 30,000 h for a long life lamp with a non-cycling characteristic. The non-cycling feature protects the luminaire starter from burning out and allows for positive indication of lamp burn out for maintenance crews.

The dual arc tube lamp is not standard; however, the lighting designer may apply for special permission for particularly remote locations with specific maintenance concerns.

E6.2.5.5 Luminaire Distribution Type

The standard type 2 or 3 lighting distribution pattern (see Figure 5.2) shall be used for all cobra head style and tunnel or underpass luminaires. The type 2 lighting pattern is generally suitable for highway widths of 2 lanes in total. An increased road width is best lit by a type 3 lighting pattern luminaire.

High mast luminaires shall be either type 4 or 5 lighting distribution patterns.

Post top luminaires on 6 m poles shall be either type 3 (to light only long walkways) or type 5 (for wide area lighting).

E6.2.5.6 Luminaire Cutoff Classification

A "medium semi-cutoff" class luminaire shall be used for all cobra head style luminaires in rural locations. In urban areas with detailed municipal bylaws or policies on luminaire type to limit "skyglow" or light pollution trespass and glare, or areas with special circumstances such as near observatories or airports, a "cutoff" class luminaire may be used.

Tunnel and underpass luminaires shall use the "semi-cutoff" rating whenever possible but may vary to meet the design criteria as required.

High mast luminaires shall use a flat or convex glass with a cutoff rating.

Post top luminaires may use a non-cutoff classification.

E6.2.5.7 Optical Chamber Sealing Standard

All luminaires shall have a CSA "wet" location standard as well as an Ingress Protection (IP) rating of 65. This rating allows for complete protection against entry from dust and protection against a "low pressure" jet of water from all practical directions.

E6.2.5.8 Photo Control of Luminaires

Photo controls shall be vandal resistant and be oriented to the north. The photo control location shall be on the side or back of the power cabinet but only if the location is free of trees, not susceptible to vehicle headlight interference or thrown snow from snowplows. In most cases, the power cabinet can be positioned to have the photo control face north, however in some cases, it may be necessary to order the power cabinet with a specific photo control orientation.

Another approved location for the photo control is on top of the nearest light pole and have a 3C#12 AWG control cable return to the lighting contactor(s) to operate the roadway lights.

The photo control shall operate the individual lighting branch circuits. This will facilitate using the Alberta Transportation owned power source for alternate unswitched power requirements such as traffic signals and flashing median lights or flashing pedestrian crossings.

The photo control shall be connected in a normally closed wiring method. Any component failure shall result in the lamps remaining on continuously. The photo control shall be factory set for turn-on at 10 lux and turn-off at 30 lux.

E6.2.6 Wiring Methods

All wiring from the utility meter location to the luminaire must adhere to CEC Part 1 code regulations for cables, wires and conduits.

The acceptable wiring methods include copper Teck 90 armored cable and a conduit (PVC, HDPE or DB2) with RW90 copper X-link wiring method. Generally, the conduit and wire system is only used to match to an existing urban centre wiring method. A conduit system also includes flush mounted junction boxes, which are difficult to protectively place in a rural environment (without curbs). However, it is not the intent to limit rural installations to the armored cable method only. Special permission for alternate and CEC Part 1 acceptable wiring methods may be applied for to Alberta Transportation.

The existing lighting infrastructure installed largely by electric utilities is comprised almost entirely of aluminum USEB cable. This cable is currently not openly approved for use in branch circuits for roadway lighting applications under CEC Part 1. However, if special permission can be obtained from the local inspection authority for a specific roadway lighting project, then it can be used. If the inspection authority approves the use of aluminum USEB cable, the lighting contractor shall use an acceptable penetrating oxide inhibiting compound on all terminations.

All wire and cables shall be sized to meet the 80% branch circuit loading capacity and account for allowable voltage drops. They may be individually sized. All terminations shall be in accordance with CEC Part 1, including the requirements of mechanical termination of Teck 90 armour.

Direct bury cable splices are not permitted except for maintenance. When permitted, splices shall be crimp type with a complete epoxy cover suitable for direct burial.

Junction boxes, when used, shall be of the flush type and rated for heavy-duty use such as a vehicle drive-over rating. The box shall have an open bottom to allow for drainage and strength and all splices shall be suitable for normally wet locations.

The typical wiring method shall include a "daisy chain" radial branch circuit using the pole hand holes as splice points. A non-terminated and marked cable may also link the end of two radial branch circuits to facilitate expedient contingency switching by maintenance personnel of various roadway lights when a cable failure occurs, without the need for overhead temporary wiring. However, the local inspection authority must approve this wiring method.

All circuits shall meet the grounding requirements of CEC Part 1.

Electrical protection of the branch circuits shall be achieved with the use of bolt-on style breakers in the distribution panel. Generally, these will be 15 A rated two pole breakers for 240 V circuits, however other breaker sizes to accommodate circuit loading is allowed. Individual 10 A fusing (2 per 240 V circuit) in each pole hand hole shall also be included. This fusing is meant to enable sectionalizing of local faulted light locations as well as a break-away point in the wiring system for limiting cable damage during a possible impact. In the case of 1000 W high mast applications, the inline fuses shall be rated 15 A for each circuit that feeds 2 luminaires.

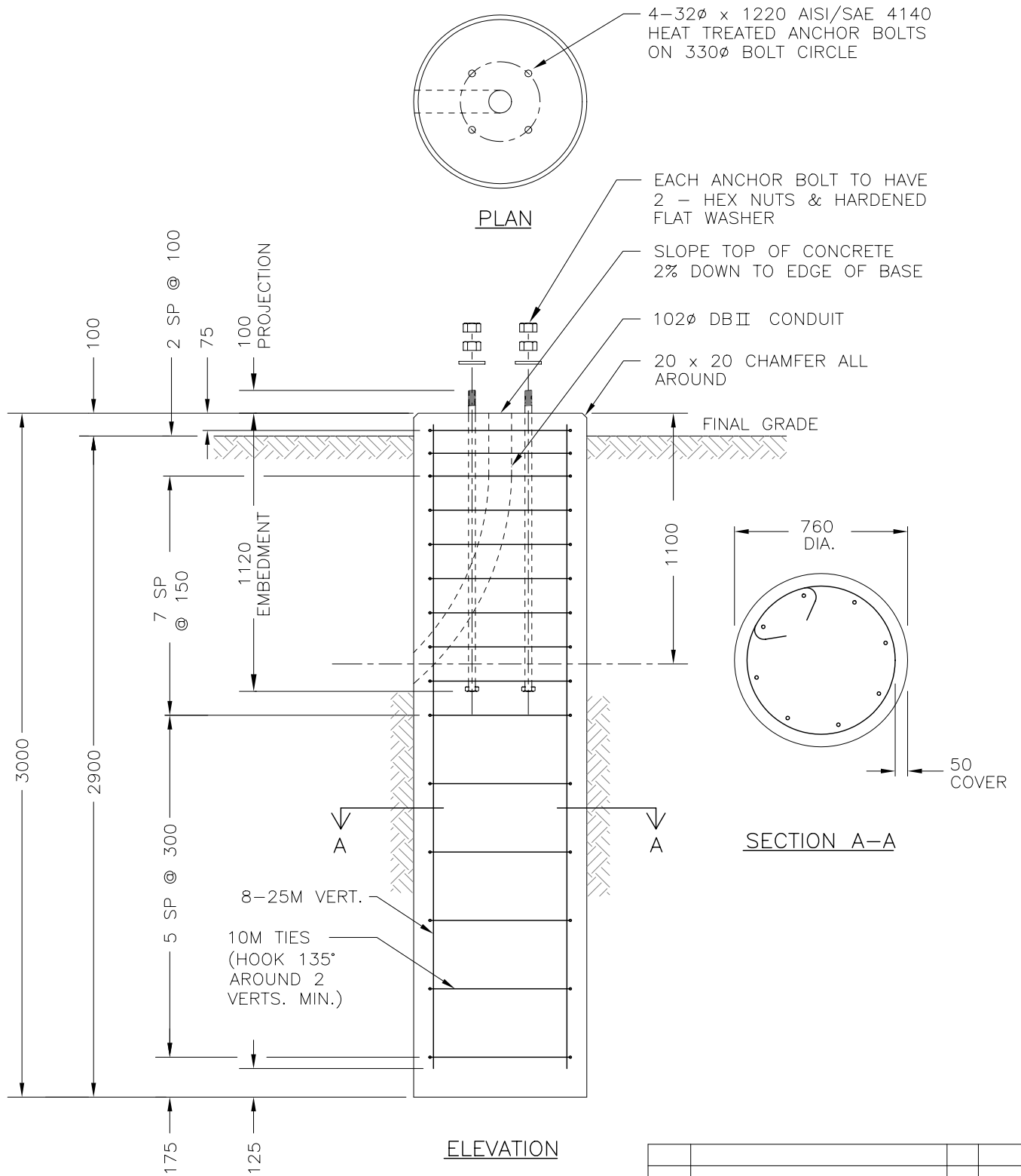
E6.2.7 Power Distribution Cabinets


The power distribution cabinet shall be of sufficient size to support the known and reasonably anticipated future loads. It shall meet the criteria listed in Section E5.6 and Drawings TCS-E-630.1 and TCS-E-630.2. The cabinet shall house a single phase 120/240 volt supply unless a three phase supply is warranted and accepted for a particular project. A rationale for this method is listed in Section E6.2.5.2.

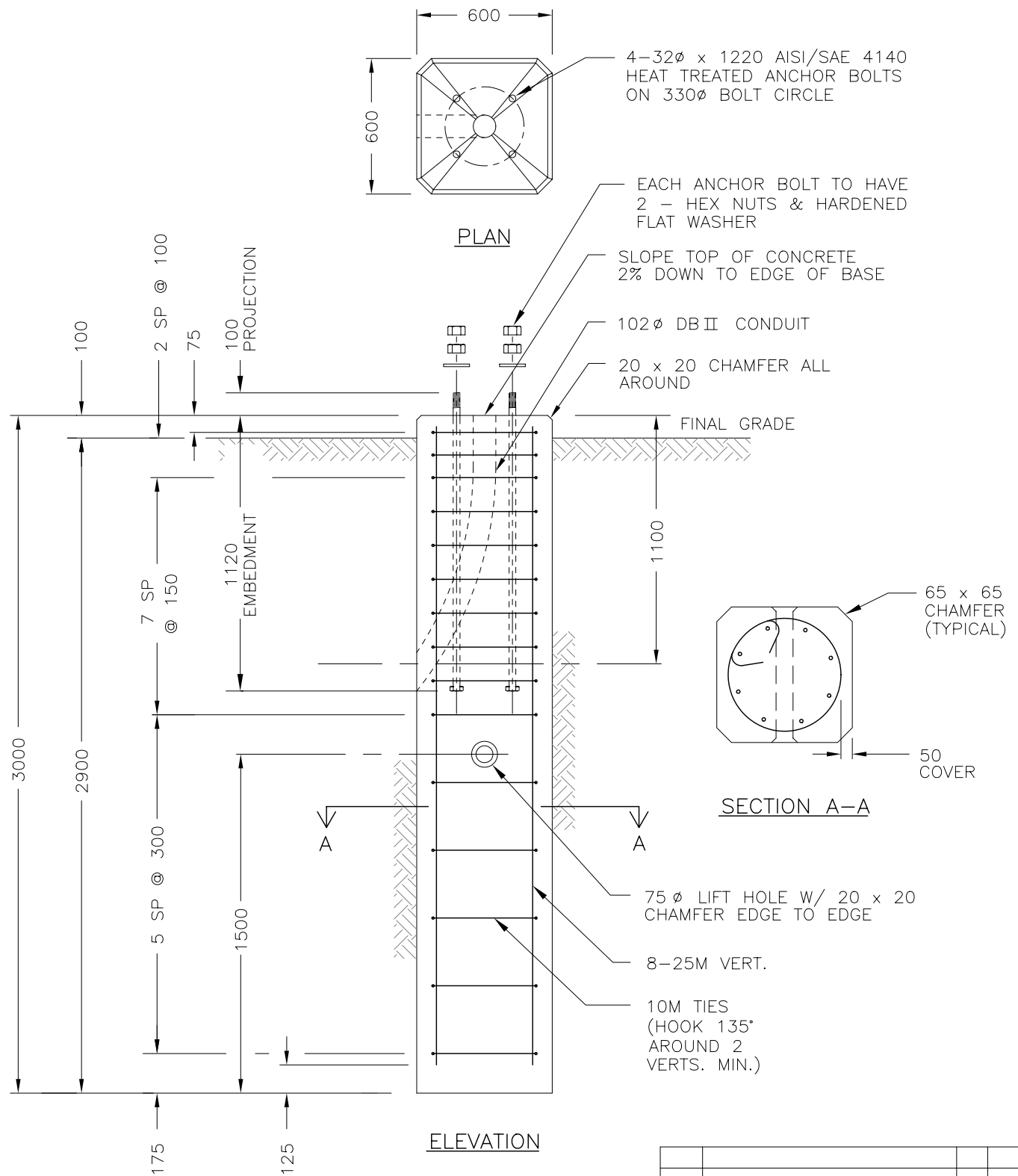
A concrete base for Type A and Type B power distribution cabinets is shown in Drawing TCS-E-601.5.


E6.3 Non-Standard Lighting Components

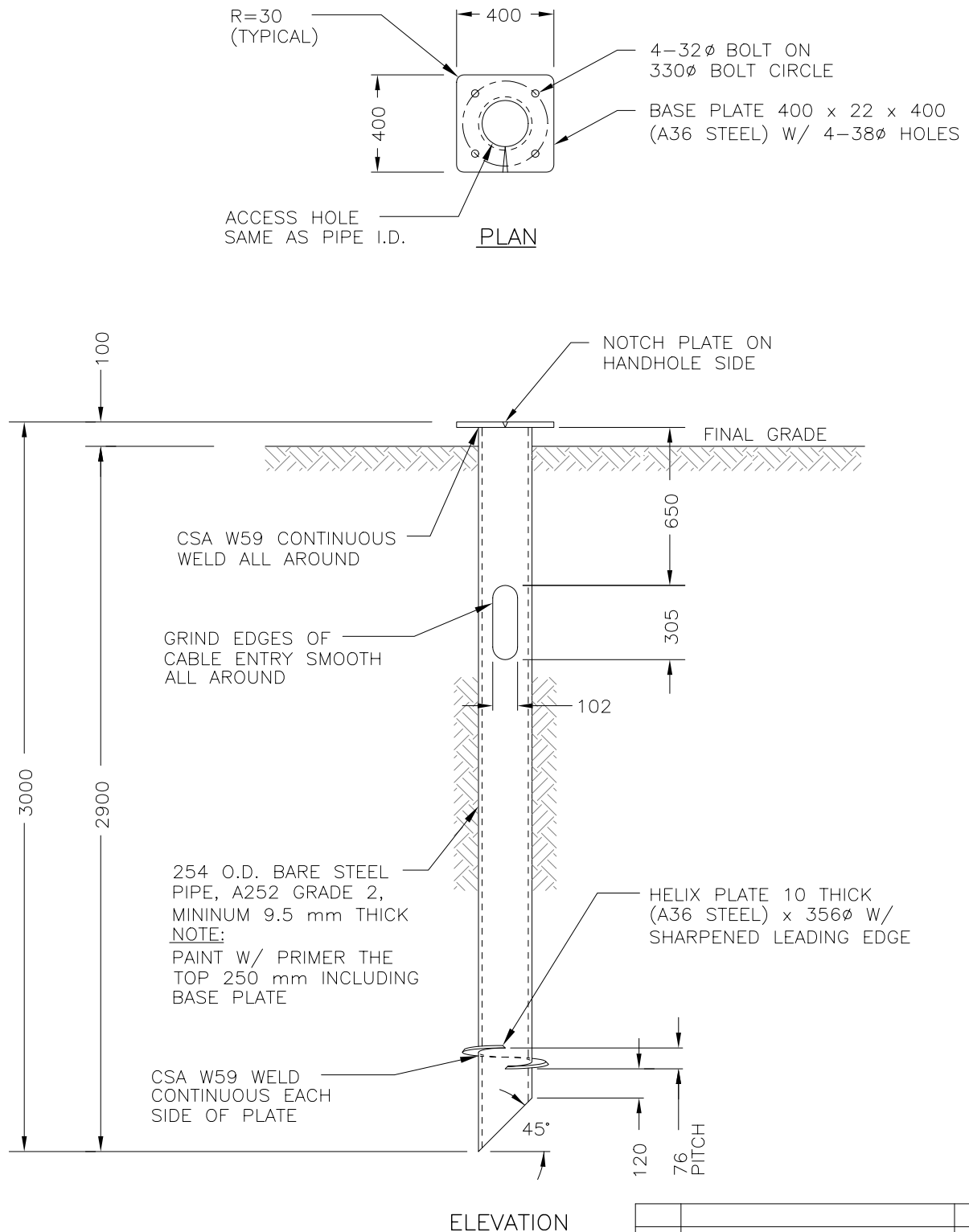
It is the intent of this guide to promote the best available lighting designs and as such will make allowances for new and emerging lighting equipment (power supplies, controls, wiring, bases, poles, luminaires and lamps). The lighting designer must justify any design that promotes a non-standard lighting component.




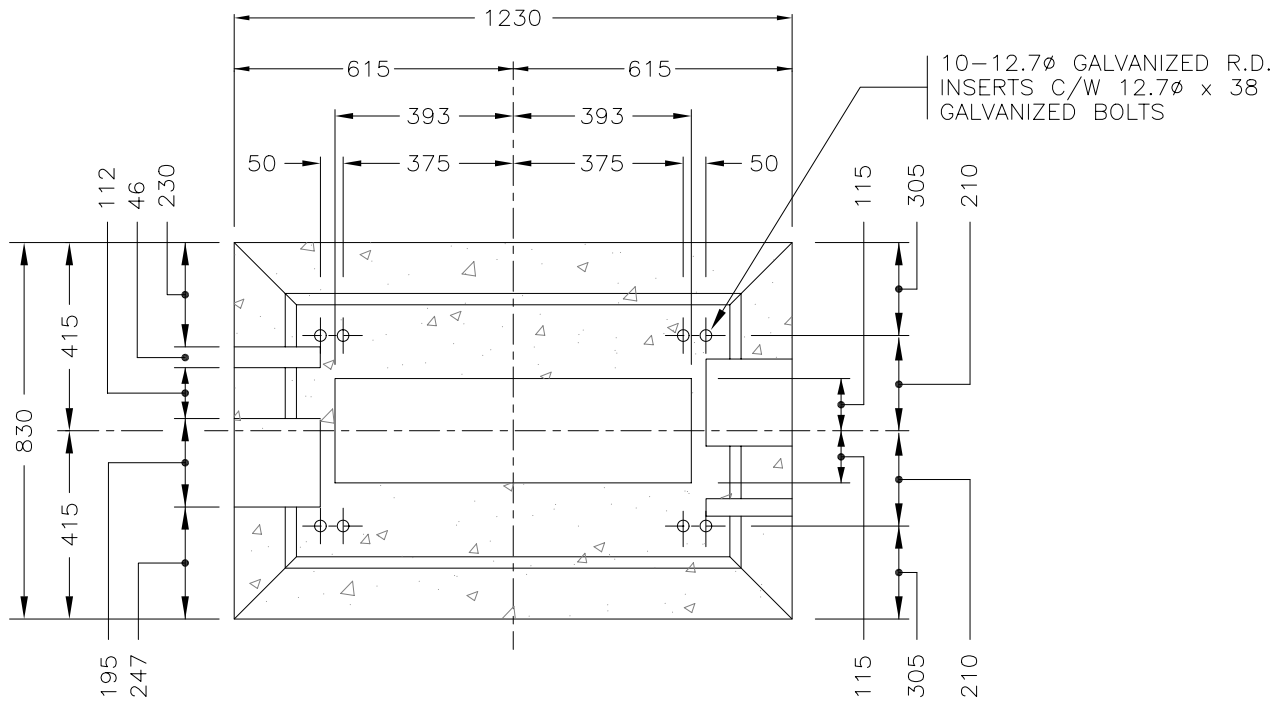
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		DRAWING TCS-E-601.1	
		Date: MAR 2003	
ROADWAY LIGHTING CAST-IN-PLACE CONCRETE BASE FOR UP TO 15 m DOUBLE DAVIT			
Prepared By: GY	Checked By: DE	Scale: N.T.S.	SECTION E6



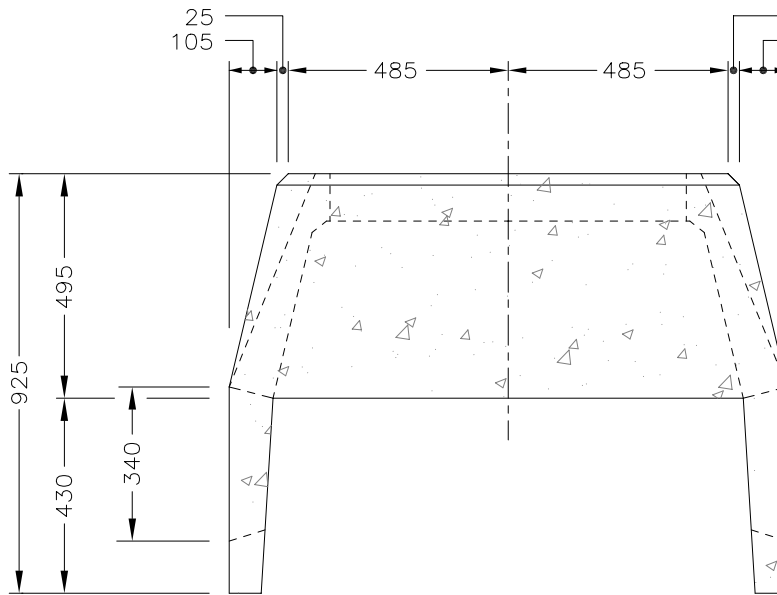
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Prepared By: GY	Checked By: DE	Scale: N.T.S.	SECTION E6



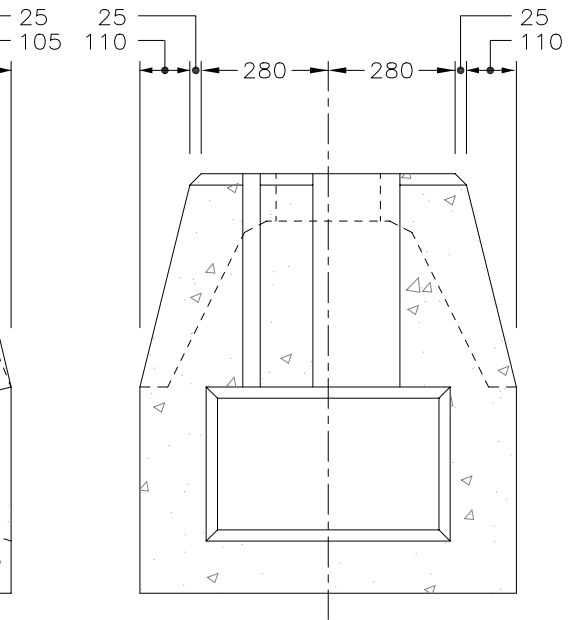
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		Date: MAR 2003	
ROADWAY LIGHTING SCREW PILE STEEL BASE FOR UP TO 15 m DOUBLE DAVIT			
Prepared By: GY	Checked By: DE	Scale: N.T.S.	SECTION E6




TOP VIEW

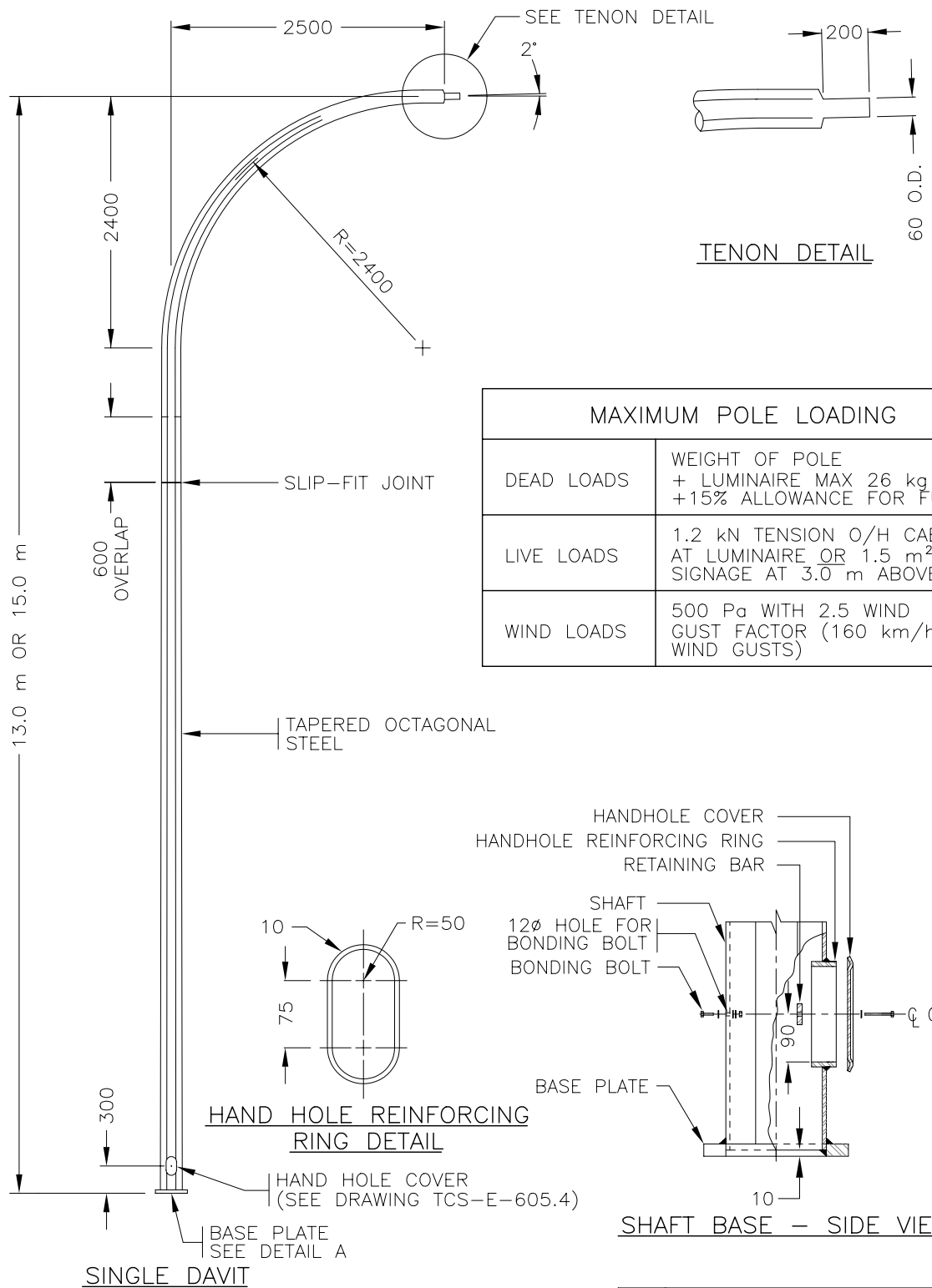


FRONT VIEW



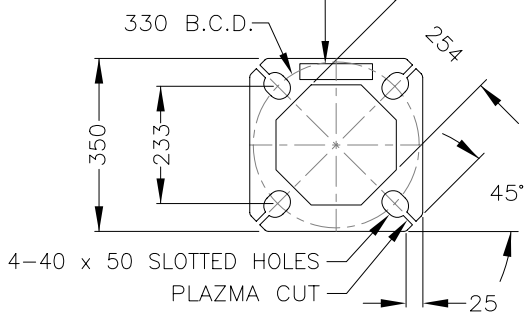
SIDE VIEW

No.	DESCRIPTION	BY	DATE
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		Date: MAR 2003	
ROADWAY LIGHTING CONCRETE BASE FOR TYPE A AND B POWER DISTRIBUTION CABINET			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E6




MAXIMUM POLE LOADING	
DEAD LOADS	WEIGHT OF POLE + LUMINAIRE MAX 26 kg MASS +15% ALLOWANCE FOR FUTURE
LIVE LOADS	1.2 kN TENSION O/H CABLE AT LUMINAIRE OR 1.5 m ² SIGNAGE AT 3.0 m ABOVE GRADE
WIND LOADS	500 Pa WITH 2.5 WIND GUST FACTOR (160 km/h WIND GUSTS)

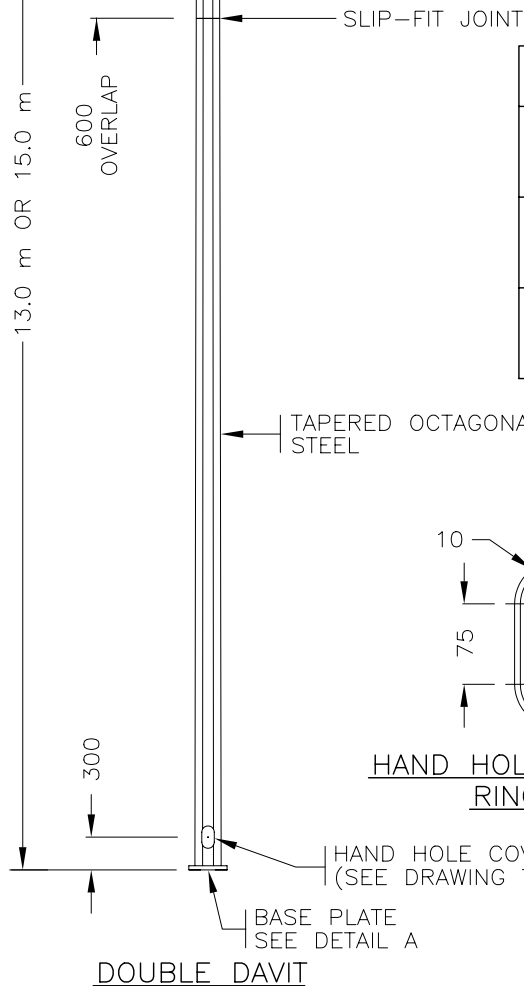
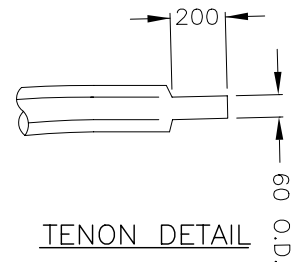
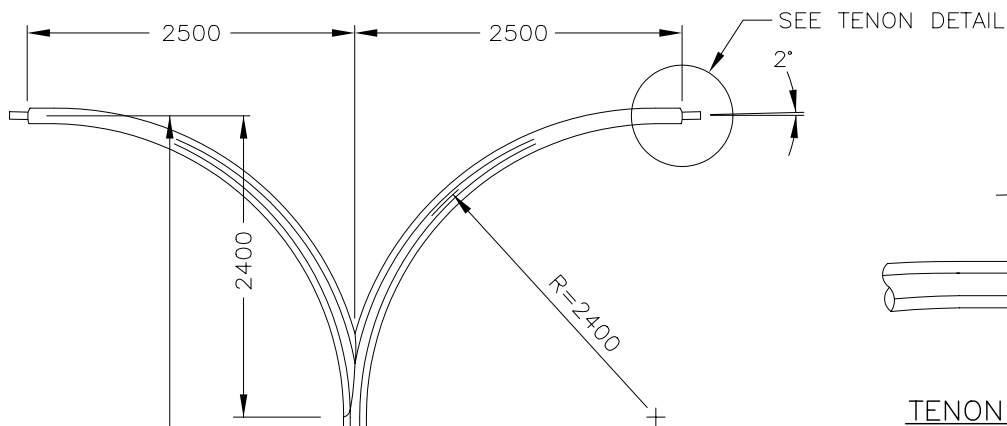
STAMP MANUFACTURERS
NAME, YEAR MANUFACTURED
AND POLE WEIGHT (TYPICAL)



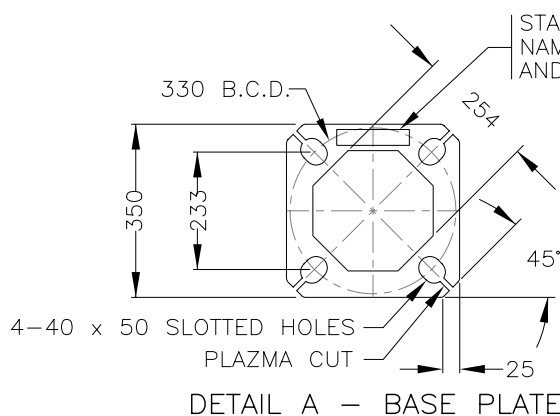
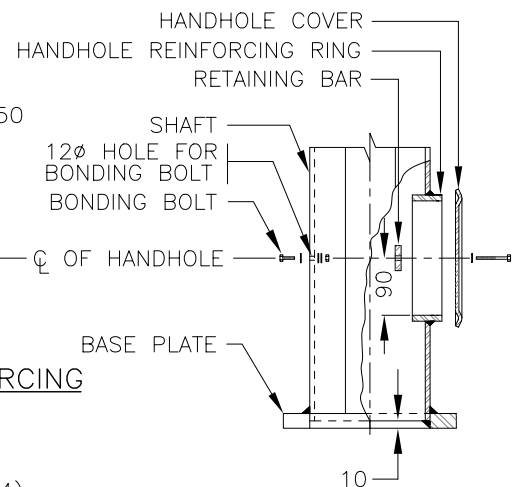
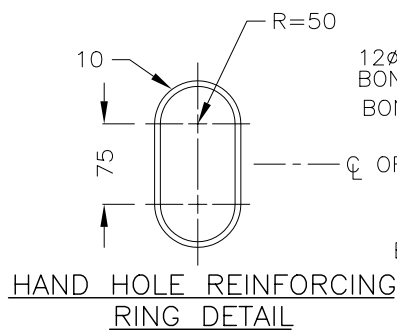
DIMENSIONS ARE MILLIMETRES
UNLESS OTHERWISE NOTED



No.	DESCRIPTION	BY	DATE
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		Date: MAR 2003	
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Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E6




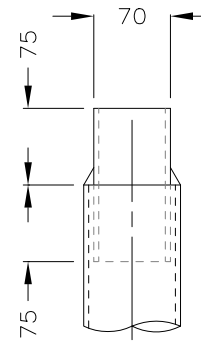
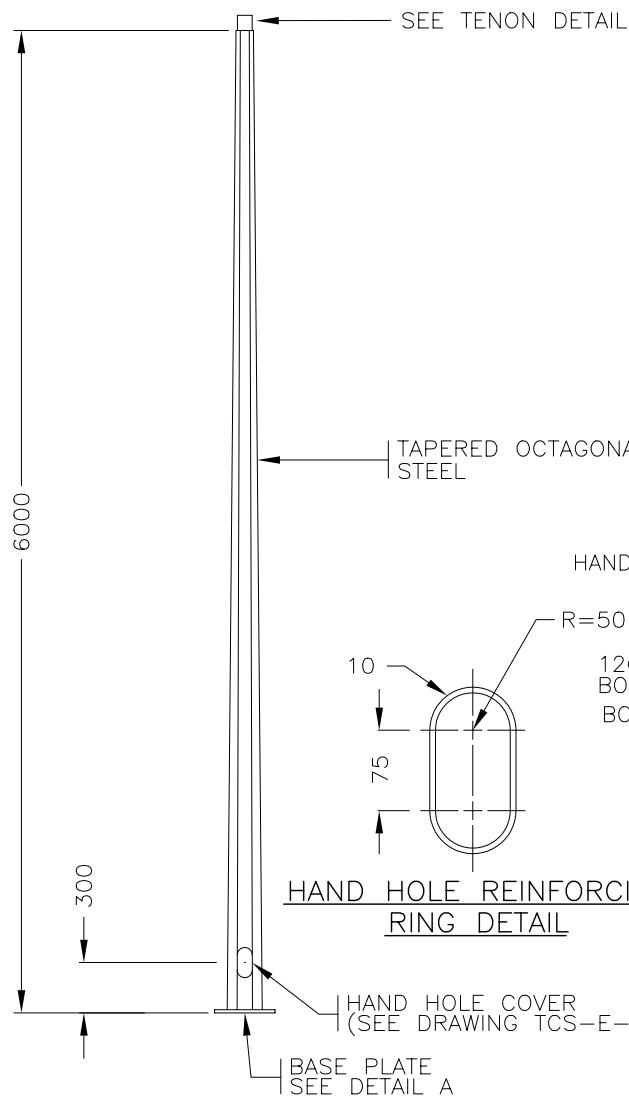
MAXIMUM POLE LOADING	
DEAD LOADS	WEIGHT OF POLE + LUMINAIRE MAX 26 kg MASS +15% ALLOWANCE FOR FUTURE
LIVE LOADS	1.2 kN TENSION O/H CABLE AT LUMINAIRE OR 1.5 m ² SIGNAGE AT 3.0 m ABOVE GRADE
WIND LOADS	500 Pa WITH 2.5 WIND GUST FACTOR (160 km/h WIND GUSTS)



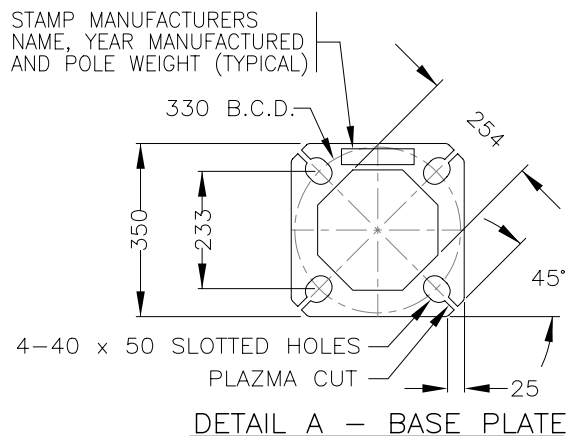
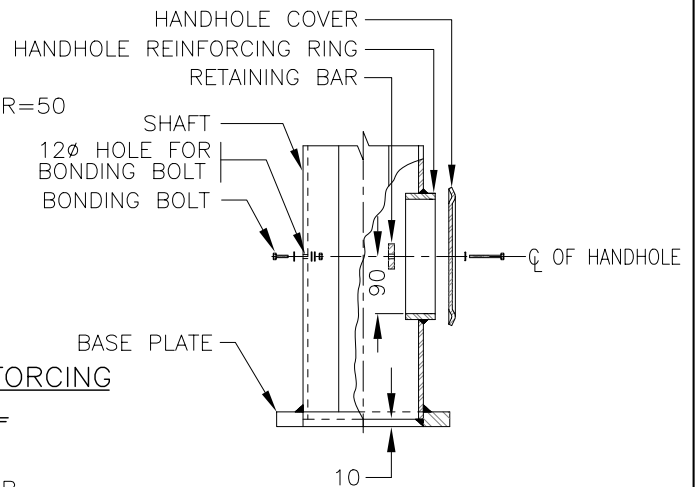
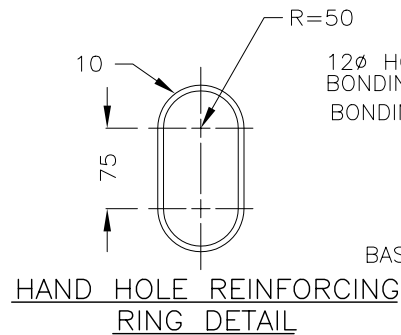
DIMENSIONS ARE MILLIMETRES
UNLESS OTHERWISE NOTED



No.	DESCRIPTION	BY	DATE
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		Date: MAR 2003	
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Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E6



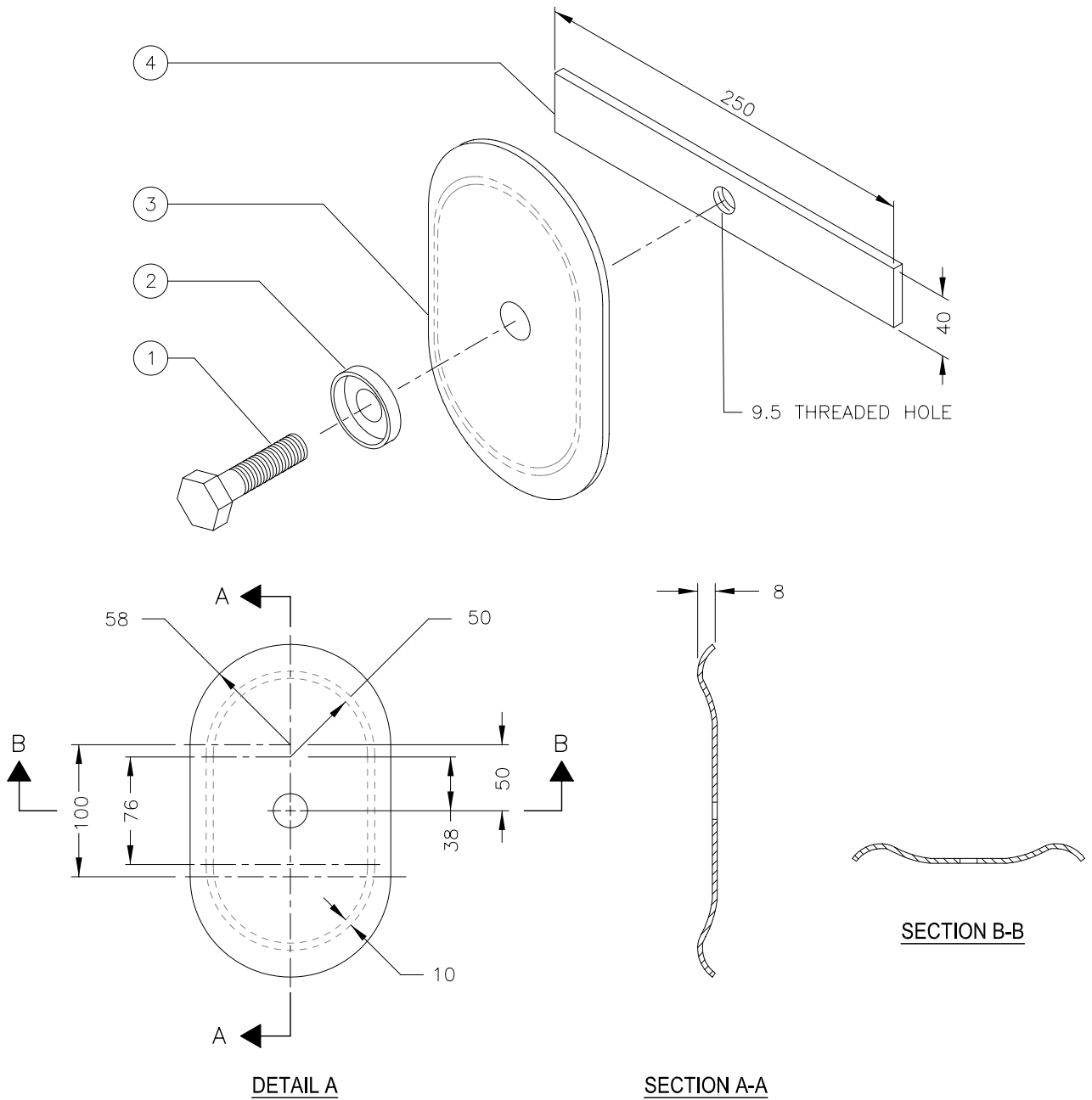
TENON DETAIL




MAXIMUM POLE LOADING

DEAD LOADS	WEIGHT OF POLE + LUMINAIRE MAX 26 kg MASS +15% ALLOWANCE FOR FUTURE
LIVE LOADS	AS PER INDIVIDUAL REQUIREMENTS
WIND LOADS	500 Pa WITH 2.5 WIND GUST FACTOR (160 km/h WIND GUSTS)

No.	DESCRIPTION	BY	DATE
		DRAWING TCS-E-605.3 Date: MAR 2003	
ROADWAY LIGHTING STRAIGHT SHAFT POLE 6.0 m			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E6

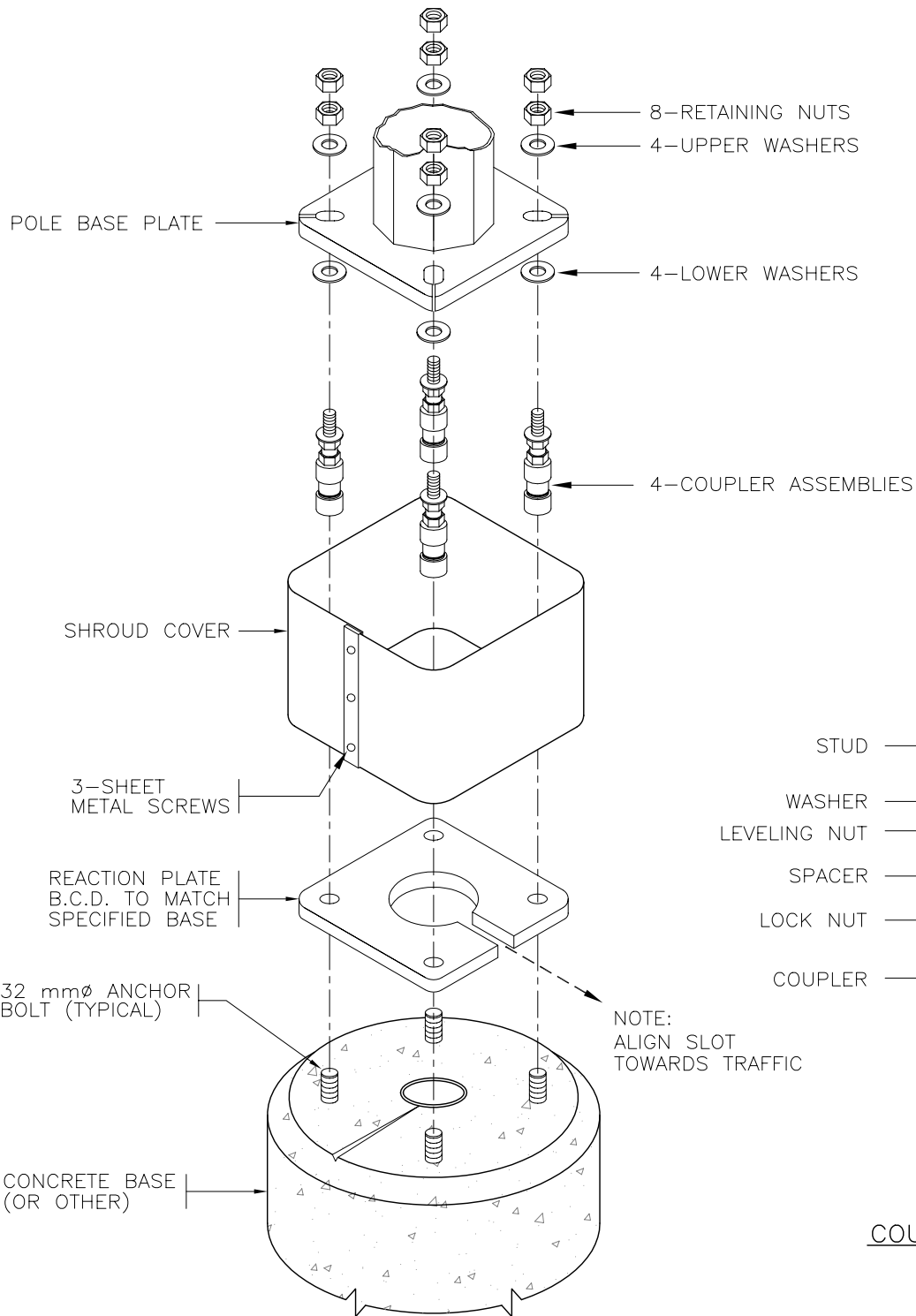


MATERIAL LIST		
ITEM	QTY	DESCRIPTION
1	1	3/8" GALVANIZED BOLT WITH 9/16" HEX HEAD 2 1/4" LG. X 1 3/4" THREADED
2	1	GALVANIZED CUP WASHER (INSIDE DIA. 13/16")
3	1	HANDHOLE COVER
4	1	RETAINING BAR 40 mm x 250 mm x 6.35 m

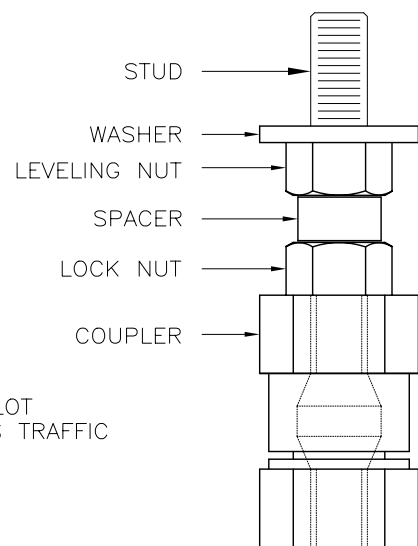
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		Date: MAR 2003	
ROADWAY LIGHTING POLE SHAFT HAND HOLE COVER ASSEMBLY			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E6

DIMENSIONS ARE MILLIMETRES
UNLESS OTHERWISE NOTED





BREAKAWAY BASE ASSEMBLY




COUPLER ASSEMBLY

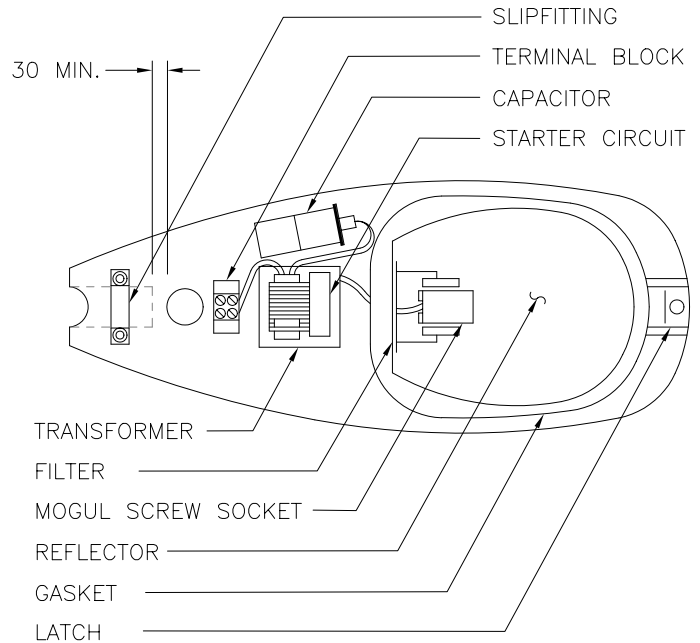
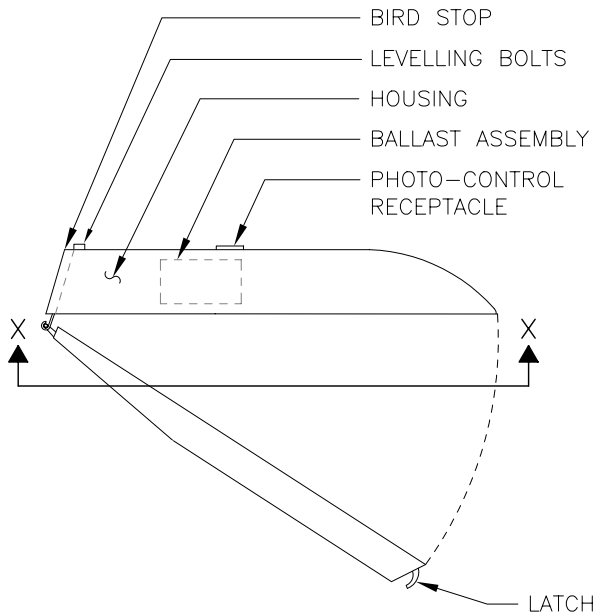
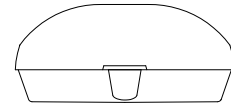
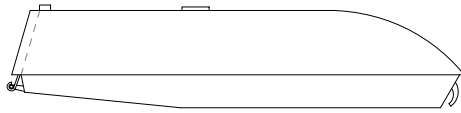
NOTE:

1. INSTALL BASE AND TIGHTEN BOLTS AS PER MANUFACTURERS INSTRUCTIONS.

DIMENSIONS ARE MILLIMETRES
UNLESS OTHERWISE NOTED




No.	DESCRIPTION	BY	DATE
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		Date: MAR 2003	
ROADWAY LIGHTING BREAKAWAY BASE STREETLIGHT POLES			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E6

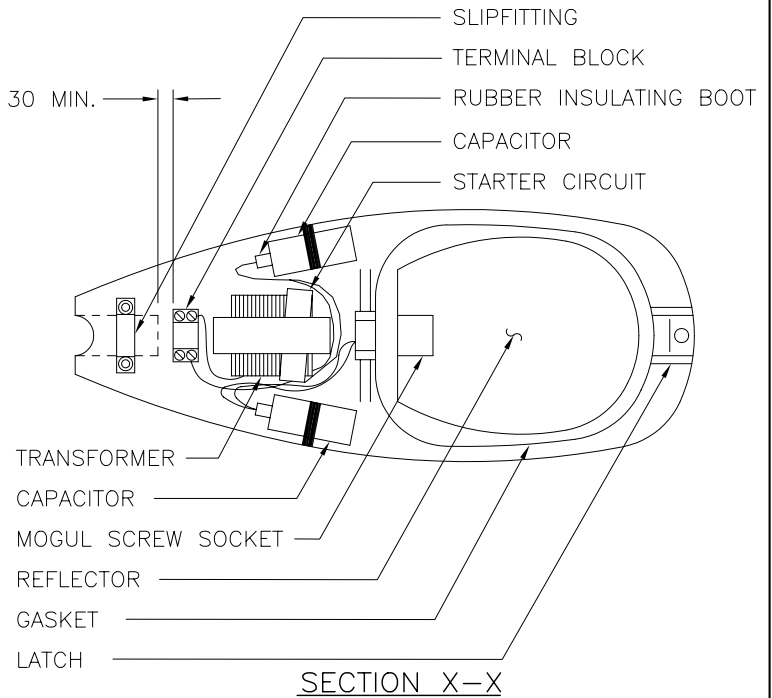
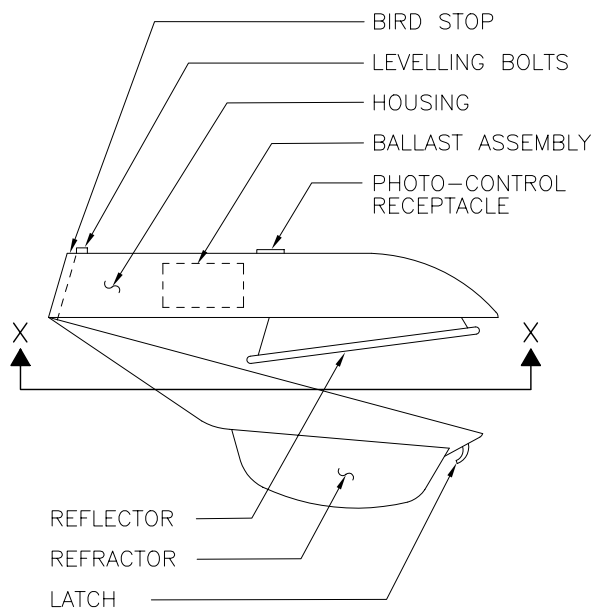
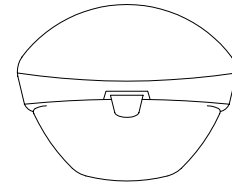
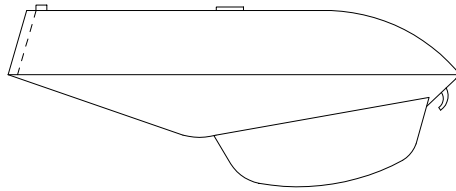


SECTION X-X

NOTES:

1. LUMINAIRES TO BE EITHER TYPE 2 OR TYPE 3 MEDIUM CUTOFF DISTRIBUTION.
2. REFER TO CHAPTER E6, SECTION E6.2.5.1 TO SECTION E6.2.5.8 FOR LUMINAIRE PERFORMANCE CRITERIA.

No.	DESCRIPTION	BY	DATE
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		Date: MAR 2003	
ROADWAY LIGHTING 250 W/400 W HPS FLAT GLASS COBRA HEAD LUMINAIRES			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E6




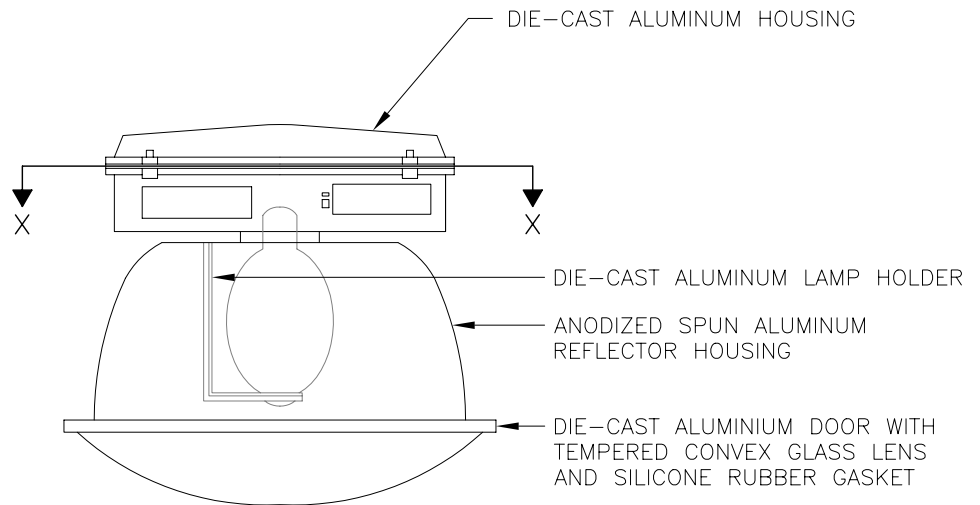
NOTES:

1. LUMINAIRES TO BE EITHER TYPE 2 OR TYPE 3 MEDIUM SEMI-CUTOFF DISTRIBUTION.
2. REFER TO CHAPTER E6, SECTION E6.2.5.1 TO SECTION E6.2.5.8 FOR LUMINAIRE PERFORMANCE CRITERIA.

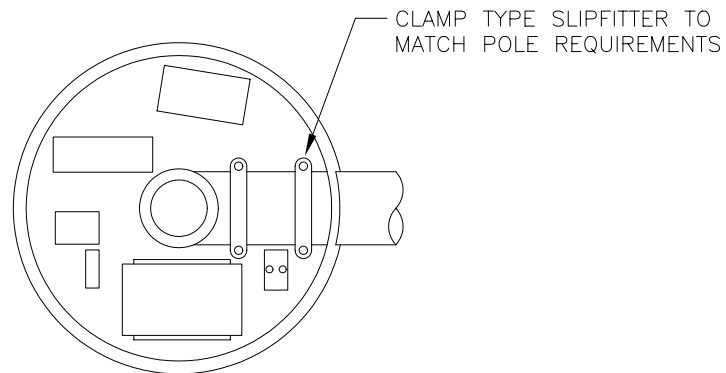
DIMENSIONS ARE MILLIMETRES
UNLESS OTHERWISE NOTED



No.	DESCRIPTION	BY	DATE
		<div>DRAWING</div> <div>TCS-E-610.2</div>	
		Date: MAR 2003	
<div>ROADWAY LIGHTING</div> <div>250 W/400 W HPS DROP GLASS</div> <div>COBRA HEAD LUMINAIRES</div>			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E6



SIDE VIEW




SECTION X-X

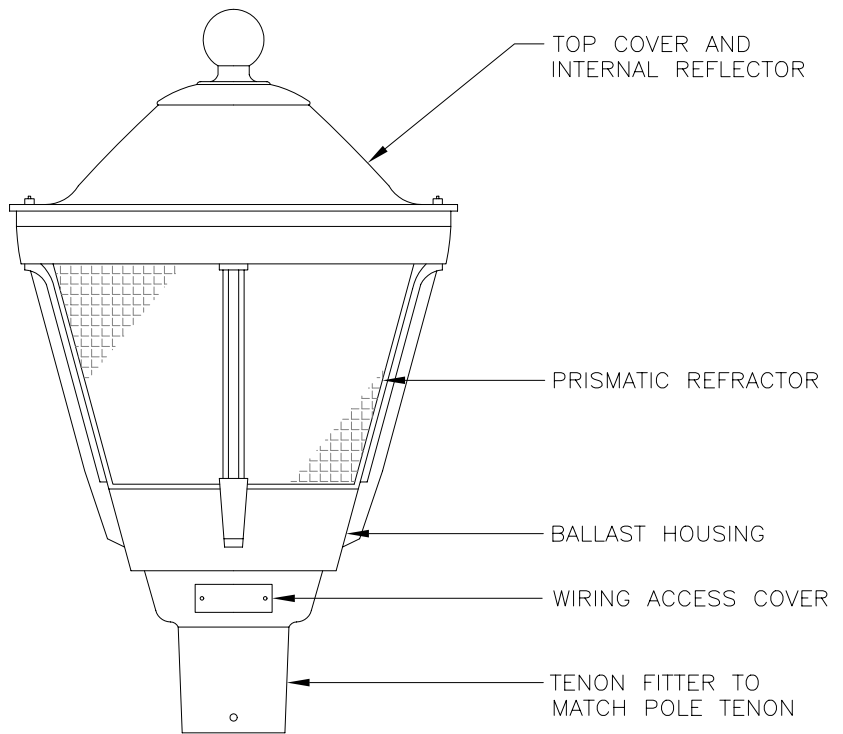
NOTES:

1. LUMINAIRES TO BE TYPE 5 CUTOFF DISTRIBUTION.
2. REFER TO CHAPTER E6, SECTION E6.2.5.1 TO SECTION E6.2.5.8 FOR LUMINAIRE PERFORMANCE CRITERIA.

DIMENSIONS ARE MILLIMETRES
UNLESS OTHERWISE NOTED




No.	DESCRIPTION	BY	DATE
		DRAWING TCS-E-610.3	
		Date: MAR 2003	
ROADWAY LIGHTING 1000 W HPS HIGHMAST LUMINAIRE			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E6

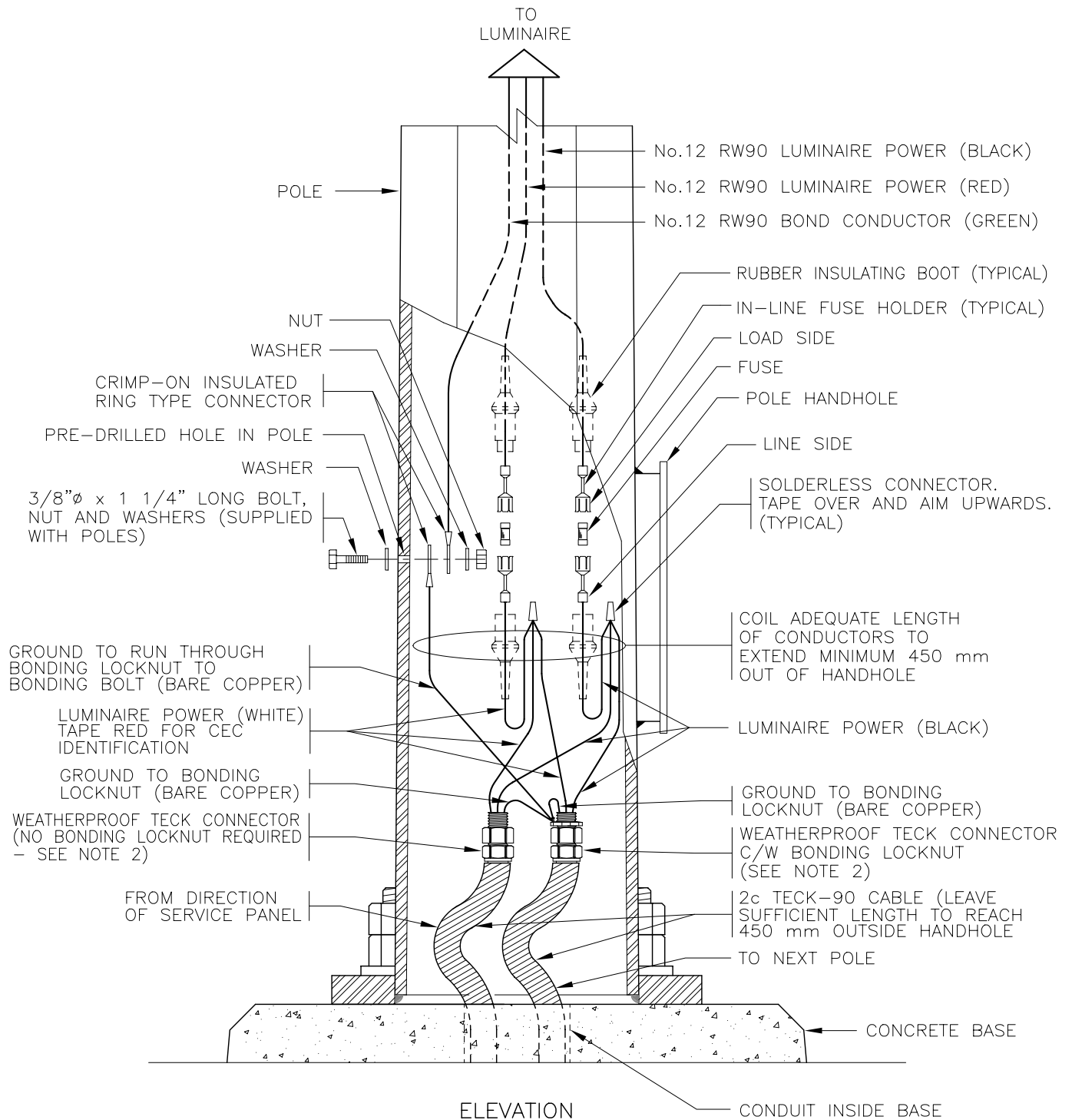


SIDE VIEW

NOTES:

1. LUMINAIRES TO BE EITHER TYPE 3 OR TYPE 5 DISTRIBUTION.
2. REFER TO CHAPTER E6, SECTION E6.2.5.1 TO SECTION E6.2.5.8 FOR LUMINAIRE PERFORMANCE CRITERIA.

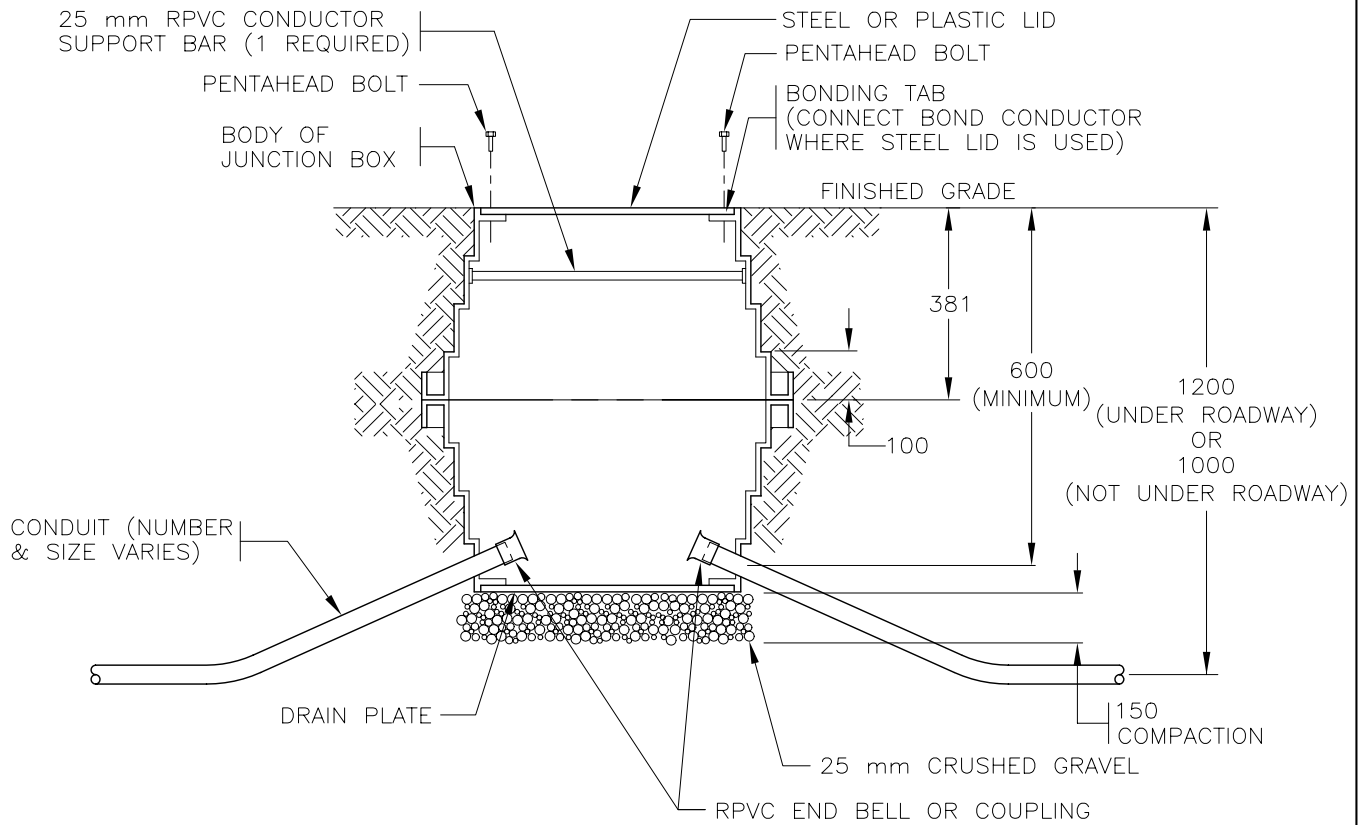
No.	DESCRIPTION	BY	DATE
		DRAWING TCS-E-610.4	
		Date: MAR 2003	
ROADWAY LIGHTING 100 W HPS POST TOP LUMINAIRE			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E6



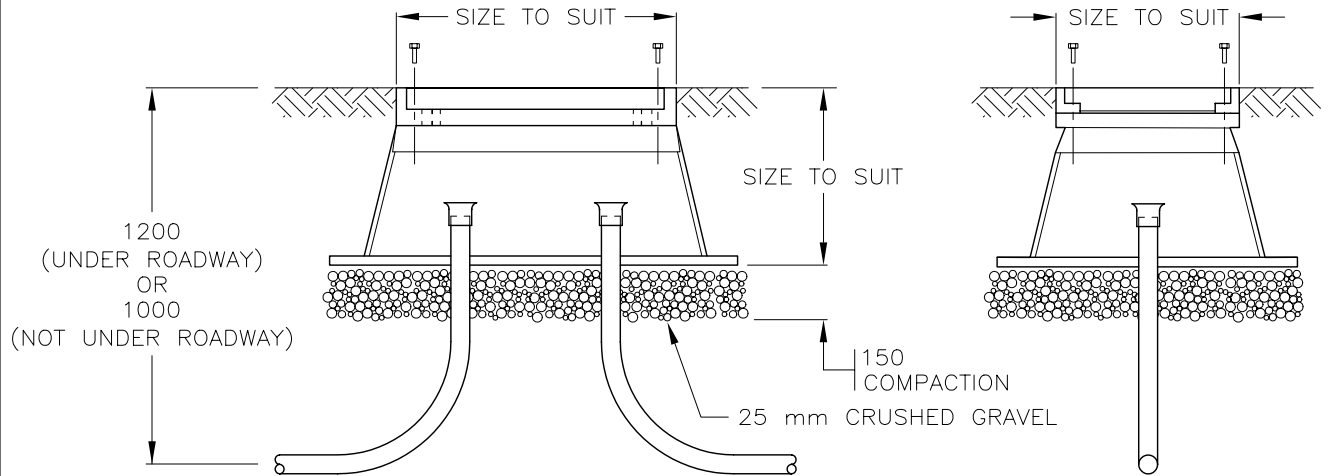
NOTES:

1. TECK-90 ARMORED CABLE WILL REQUIRE MECHANICAL TERMINATION AS PER CEC OR LOCAL INSPECTION REQUIREMENTS.
2. BOND TECK CABLE SHEATH AT 'LINE' END OF CABLE ONLY.

No.	DESCRIPTION	BY	DATE
		DRAWING TCS-E-615	
		Date: MAR 2003	
ROADWAY LIGHTING LUMINAIRE WIRING IN POLE HANDHOLE			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E6



ROUND PLASTIC JUNCTION BOX – FRONT VIEW



SQUARE PLASTIC JUNCTION BOX
FRONT VIEW


SQUARE PLASTIC JUNCTION BOX
SIDE VIEW

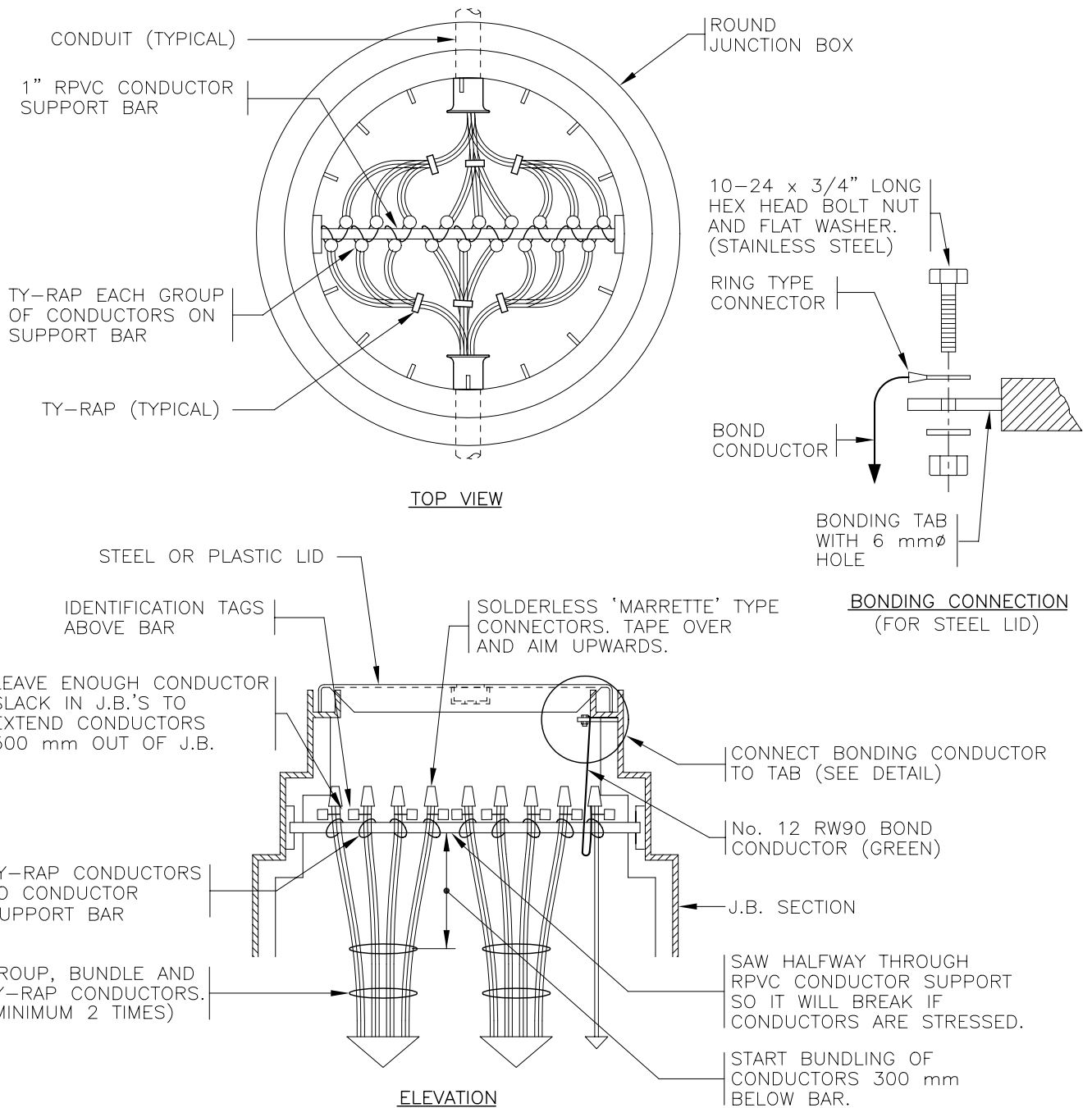
NOTES:


1. OTHER TYPES AND SIZES OF JUNCTION BOXES MAY BE USED IF THEY ARE RATED FOR HEAVY DUTY (MIN. 20 kN LOAD RATING) AND HAVE STEEL LIDS.
2. INSTALL STEEL LID ON JUNCTION BOX BEFORE BACKFILLING, TAMPING AND PAVING OPERATIONS.
3. INSTALL TOP OF JUNCTION BOX FLUSH WITH FINISHED GRADE.

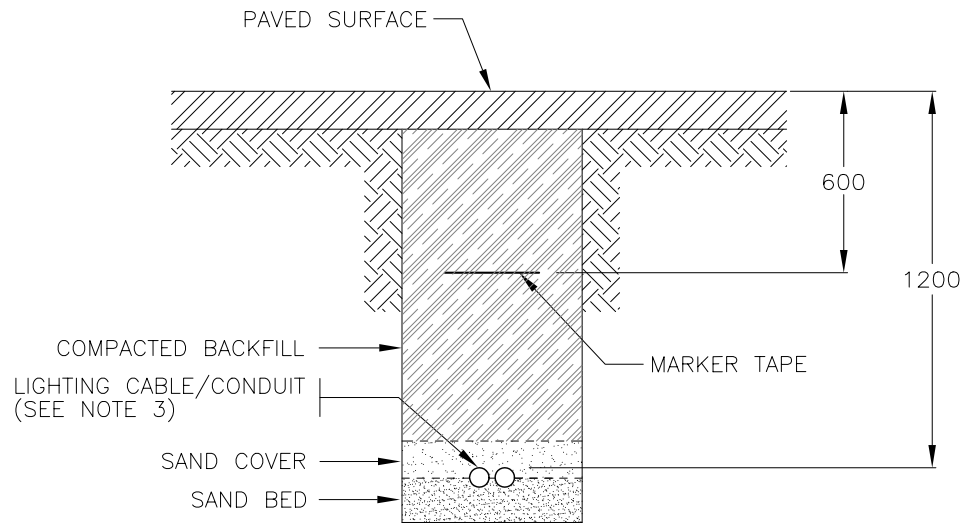
DIMENSIONS ARE MILLIMETRES
UNLESS OTHERWISE NOTED



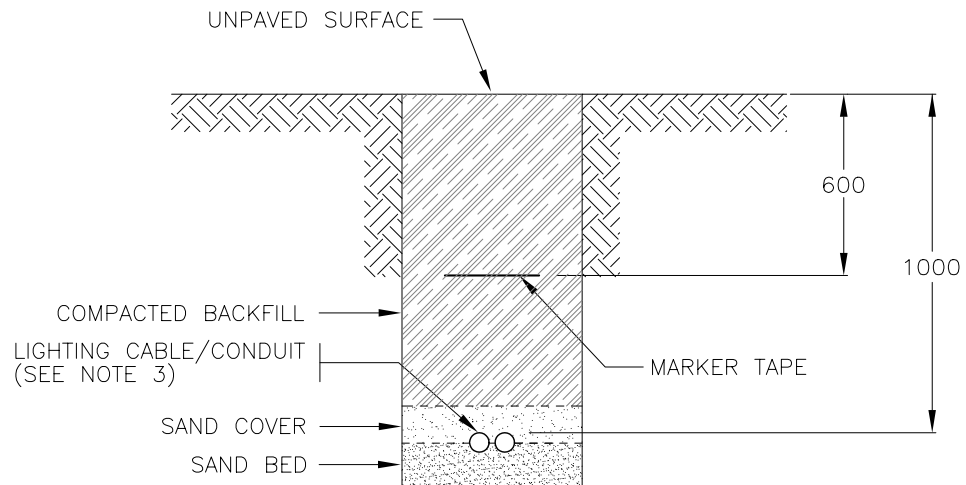
No.	DESCRIPTION	BY	DATE
 TRANSPORTATION		DRAWING TCS-E-620.1	
		Date: MAR 2003	
ROADWAY LIGHTING PLASTIC JUNCTION BOX DETAILS			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E6



No.	DESCRIPTION	BY	DATE
		DRAWING TCS-E-620.2	
		Date: MAR 2003	
ROADWAY LIGHTING ROUND PLASTIC JUNCTION BOX WIRING DETAILS			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E6



TRENCH DETAIL FOR PAVED SURFACES




TRENCH DETAIL FOR UNPAVED SURFACES

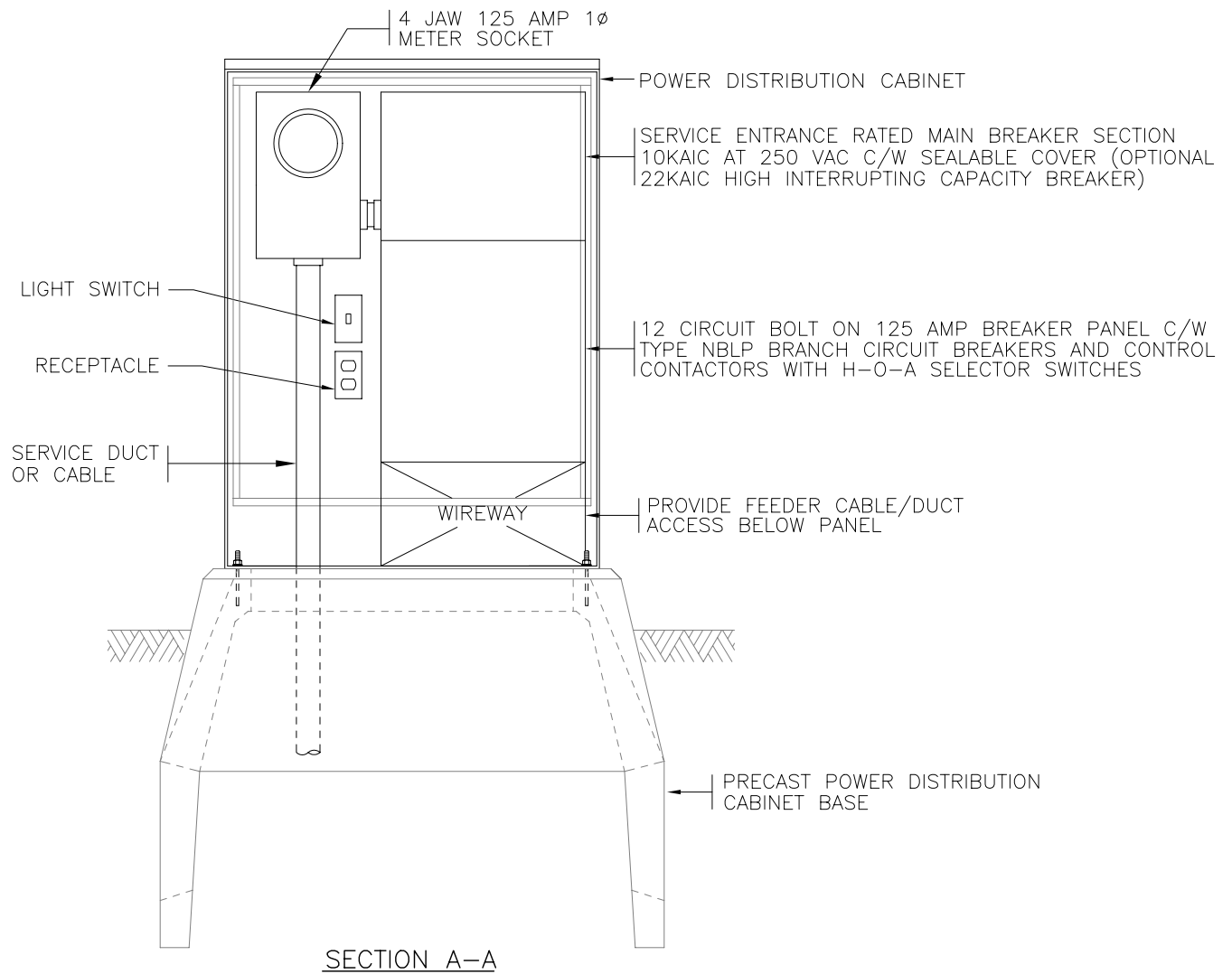
NOTE:

1. SAND BED AND COVER AS PER SPECIFICATIONS.
2. COMPACTION AS PER SPECIFICATIONS.
3. WHEN CABLE IS RUN BELOW ROADWAY, IT SHALL BE INSTALLED IN 100 mm DB2 DUCT.
4. TRENCH WIDTH AS PER SPECIFICATIONS OR AS REQUIRED.

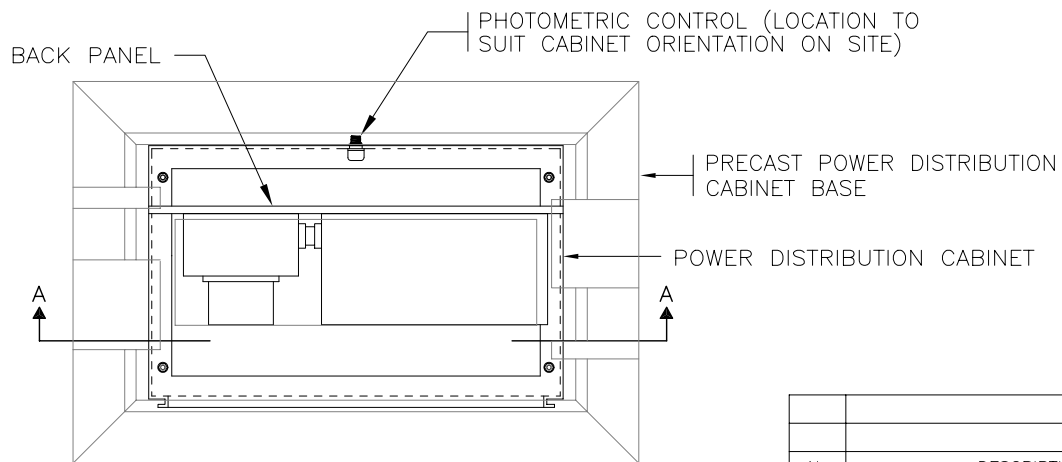
DIMENSIONS ARE MILLIMETRES
UNLESS OTHERWISE NOTED




No.	DESCRIPTION	BY	DATE
		DRAWING TCS-E-625	
		Date: MAR 2003	
ROADWAY LIGHTING TRENCH DETAILS FOR LIGHTING CABLE/CONDUIT			
Prepared By: GY	Checked By: DE	Scale: N.T.S.	SECTION E6

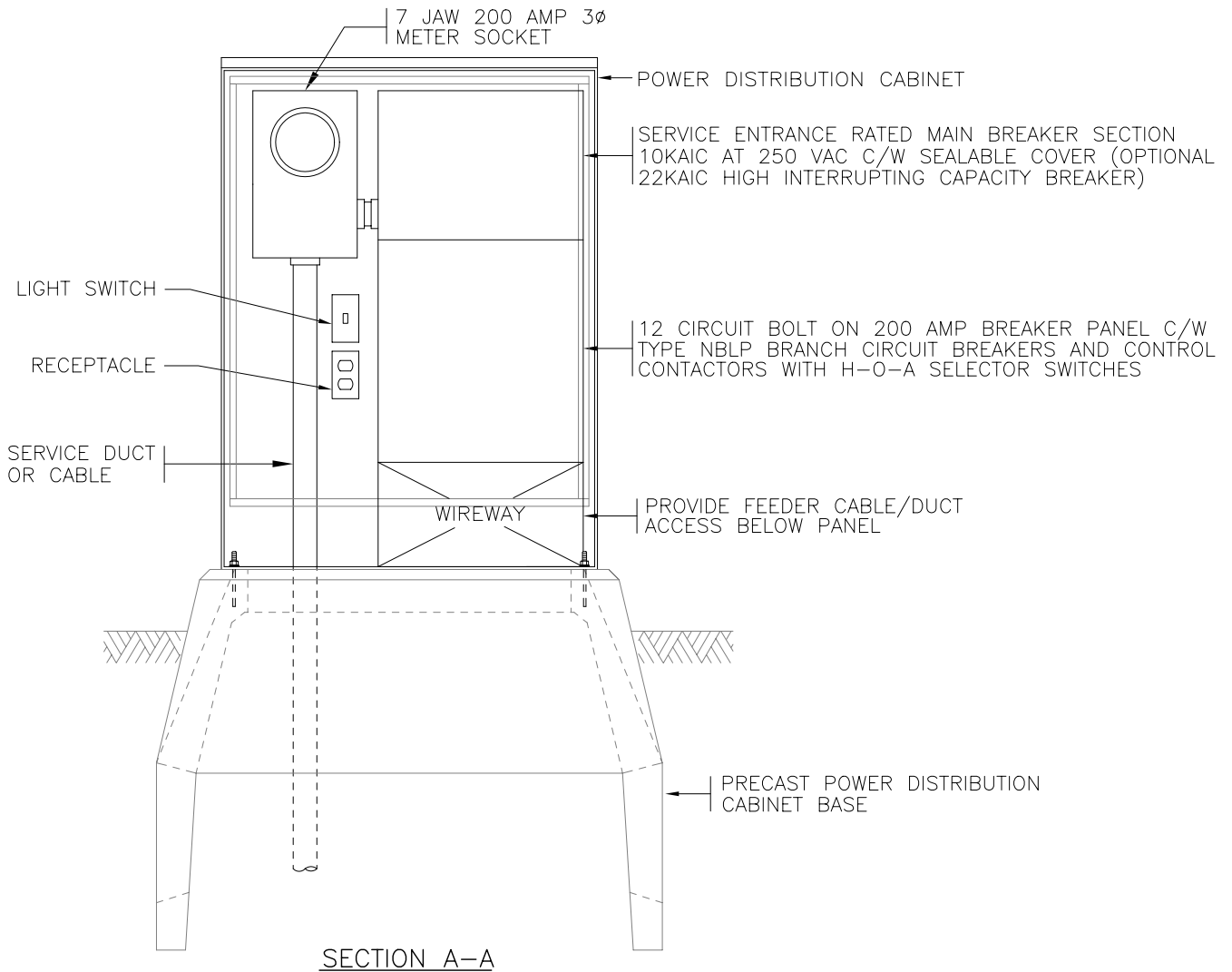


SECTION A-A

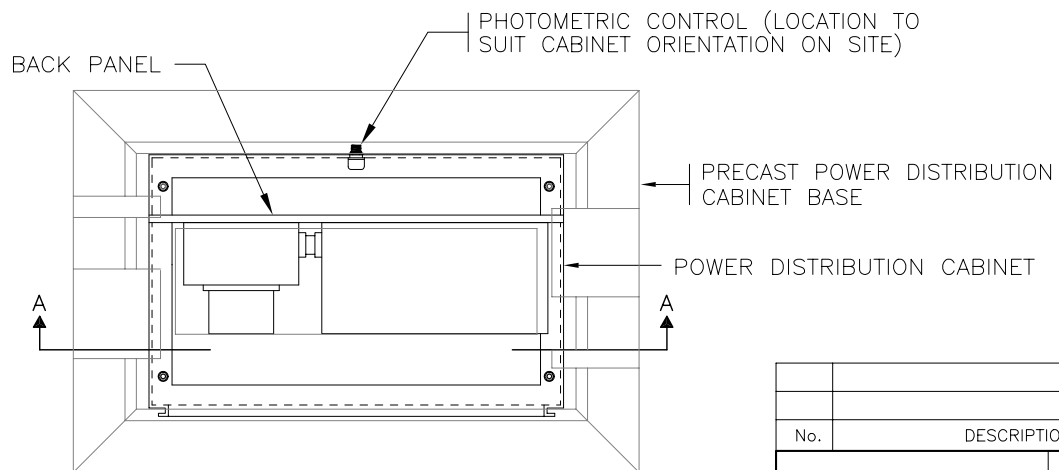


TOP VIEW


No.	DESCRIPTION	BY	DATE
		DRAWING TCS-E-630.1	
		Date: MAR 2003	
ROADWAY LIGHTING TYPE 'A' POWER DISTRIBUTION CABINET 120/240 V 1Ø 125 AMP MAXIMUM			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E6



SECTION A-A



TOP VIEW

No.	DESCRIPTION	BY	DATE
		<div>DRAWING TCS-E-630.2</div> <div>Date: MAR 2003</div>	
ROADWAY LIGHTING TYPE 'B' POWER DISTRIBUTION CABINET 120/208 V 3Ø – 200 AMP MAXIMUM			
Prepared By: DVH	Checked By: PMS	Scale: N.T.S.	SECTION E6

E7 CONSTRUCTION GUIDELINES

E7.1 Construction Phase

E7.1.1 Use of Temporary Lighting

The design guidelines outlined in Chapter E5 shall be used in cases where roadway lighting is required in the construction work zone. Lighting level and uniformity requirements shall be the same as those required for the permanent roadway lighting design, however the required pole setback shall be based on the work zone speed limit rather than the normal roadway design speed.

The *Alberta Transportation Traffic Accommodation In Work Zones Manual* provides for general requirements related to traffic control requirements through work zones.

The lighting designer shall calculate the optimum pole spacing, required setback and the luminaire to be used. Wood poles or salvaged steel davit poles on screw-in-bases from the existing or other lighting system may be used for the construction work zones.

Portable generator style temporary lighting units with an attached low mast assembly are not permitted. The low mast does not elevate the luminaires high enough to position them downwards. The typical low mast configuration creates unacceptable lighting coverage and could create intense glare to motorists.

The temporary luminaires may be electrically fed overhead using duplex or triplex cable to the nearest power source. The construction contractor shall obtain specific approval prior to the installation of any overhead cables crossing a provincial

highway. A minimum of 7.0 m from the sag point to the driving surface must be provided. Additional allowance must be provided if there are other influencing factors such as the existence of a "high load corridor".

On high mast lighting projects, temporary lighting requirements may be met through proper staging of the high mast assemblies early in the project.

Any base, pole, cable, luminaire or lamp used in a temporary lighting system shall not be reused in the final project lighting system.

E7.1.2 Identification of Poles and Luminaires

A pole and luminaire identification system exists to assist in management and maintenance of the roadway lighting assets. The following system shall be used to identify all new lighting installations.

The lighting designer shall determine the pole identification number for each lighting pole in the design. This identification shall appear next to the pole on the lighting design drawings.

Each pole shall have a five part code on a metal plate that is to be field installed (not factory installed). The code is based on the Alberta legal land description system.

EXAMPLE:

SS	(two digit) Section (1-36).
TTT	(three-digit) Township (1-126).
RR	(two-digit) Range (1-29).
M	(one-digit) Meridian (4-6). The usual meridian designation is W5 meaning west of the 5th meridian. The code assumes west in all cases.
XYZ	(three-digit) refers to the pole designation.

If a lighting system is located along two or more section lines, the section number in the northwest corner shall be used for the numbering of all poles in close proximity.

The individual poles shall be identified as follows:

- The pole located closest to the NW corner of the intersection shall be designated as Pole "001". If lighting already exists in this section, the new poles shall be numbered sequentially following the last number currently in place.
- The pole numbering shall continue in a clockwise direction to all poles at that location.
- Where continuous lighting occurs between more than one legal section, the entire lighting system shall be identified with one centrally located legal section number. The pole numbering shall start at that location and extend out as required to identify all poles as part of that continuous lighting system.
- Future pole additions, deletions or relocations may alter a logically clockwise numbered system.
- The existing numbering given to all unaffected poles when changes occur shall not change.
- A pole replacement in the same location (e.g. due to vehicle collision, aging or other damage) shall have the same number as the original pole.

Drawing TCS-E-701.1 illustrates the pole numbering system.

The pole identification plate shall be made of 1.5 mm thick aluminum plate, 200 mm high x 50 mm wide. The pole identification numbers shall be 25 mm high and shall be stamped into the face of the plate. The numbers shall be black and face the roadway for ease of viewing. The lighting

contractor shall number the poles in accordance with the information on the contract drawings. The pole identification plate shall be installed in the field vertically secured with self tapping screws. The bottom of pole identification plate shall be mounted at a height of 2.0 m above the ground. Refer to the pole identification Drawing TCS-E-701.2.

Luminaire identification shall be limited to a wattage designation only, as shown in Drawing TCS-E-705. Information on any other specifications of the luminaire will be provided in the facility maintenance binder in the power distribution centre. The luminaire shall be supplied with a standard factory installed wattage designation for the luminaire. A 250 W luminaire shall use the code 25, a 400 W luminaire shall use the code 40 etc, removing the last digit "0" enables the use of larger and more visible numbered labels. The labels shall use black bold numbers on a yellow background and be placed on the fixture to allow for easy identification from the ground.

E7.1.3 Field Changes

The lighting contractor may not make any field design changes without written authorization from the lighting designer and Alberta Transportation. Depending on the nature of the changes, additional lighting calculations may need to be performed to ensure that the proposed lighting levels are maintained.

E7.1.4 Record Drawings

The lighting contractor is responsible for recording all construction changes on the design drawing. The drawings shall include the pole identification numbers finalized on the site. The lighting designer shall be responsible for updating the design drawings to reflect the as-built information. Electronic copies of these plans shall be

forwarded to Alberta Transportation. The lighting designer shall sign and provide minimum of six paper copies of the final record drawings as follows:

- Alberta Transportation (3 copies)
- Roadway Prime Contractor (1 copy)
- Roadway Designer (1 copy)
- Lighting Contractor (1 copy)

The lighting contractor shall provide three copies of a maintenance binder with the following information:

- A letter stating the warranty period of the installation that starts on the date on the certificate of completion.
- Manufacturer's name and contact numbers
- Recommended procedure to touch up a powder coated pole finish (including colour code), if coloured poles were used.
- Manufacturer specifications on all bases, poles, luminaires, lamps, junction boxes and power supplies regardless of their adherence to the pre-approved materials list.
- A description of the wiring materials used.
- Drawings of the lighting power cabinet including the cabinet's wiring diagram from the manufacturer.
- Circuit drawings showing the extent of the roadway lighting with references to the circuit number, the general direction of the circuit (example NW circuit) and the pole identification numbers on that circuit.
- A laminated copy of the enclosure's wiring shall be provided within the enclosure for maintenance personnel.

- Performance test results (see Section E7.1.5).
- Copies of completed inspection/commissioning forms (see Section E7.2).

E7.1.5 Testing

New roadway lighting systems shall be tested as follows:

- Testing of backfill compaction around precast bases (or within trenches) may be required as per Section E6.2.2.2.
- Each pole shall be tested for plumb level and shimmed if necessary by the contractor.
- A ground test(s) as required by the electrical inspection authority must be performed and documented by the contractor.
- The lighting power cabinet (meter, disconnect, panel, breakers, contactors photocell control), the entire underground wiring system, the luminaire and the lamp shall be tested as a complete system. The lighting contractor shall verify the operation of each lamp and circuit by placing the Hand-Off-Auto (HOA) switch in the "Auto" position, turning "on" the circuit breaker, covering the photocell control and witnessing the positive operation of the lamps in that circuit. A voltage reading at the furthest pole shall be taken to ensure compliance with the maximum voltage drop allowable.

A copy of all test data shall be included in the maintenance binders. A dated certificate of completion shall be issued to the contractor upon successful completion of all required tests and contractor sign off on the required commissioning forms.

E7.1.6 Warranty

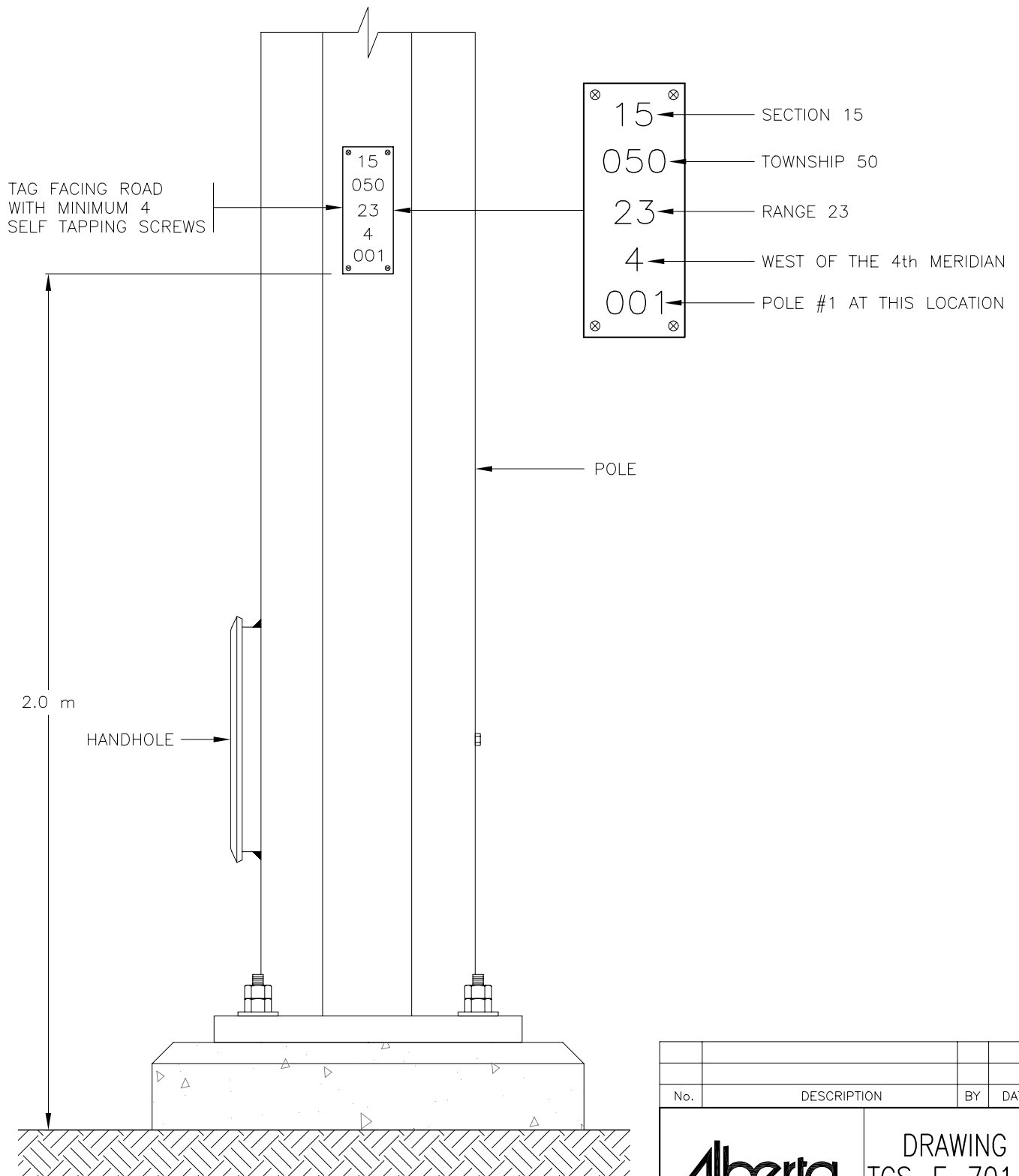
The warranty period for all new Alberta Transportation roadway lighting systems is one year. The warranty period shall begin on the date on the certificate of completion.


E7.2 Commissioning

When a roadway lighting system is installed as per the design, the computer calculated average lighting levels should be an accurate reflection of the actual average lighting levels. Measured illumination levels are rarely required.

Site inspection forms are provided in Appendix H.

Forms provided in Appendices I, J, and K shall be used to commission a new roadway lighting system and document that the lighting locations have been installed per design. These forms shall verify the pole spacing, setback and height as well as the luminaire wattage.

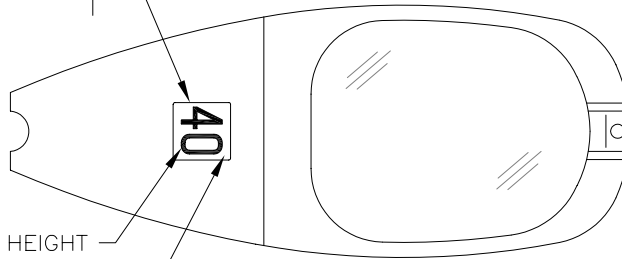


No.	DESCRIPTION	BY	DATE
		DRAWING TCS-E-701.2	
		Date: MAR 2003	
ROADWAY LIGHTING STREETLIGHT POLE IDENTIFICATION PLATE			
Prepared By: GY	Checked By: DE	Scale: N.T.S.	SECTION E7

76 mm x 76 mm
LAMP IDENTIFICATION
LABEL

54 mm TEXT HEIGHT

SEE IDENTIFICATION
LABEL LIST FOR
BACKGROUND COLOUR

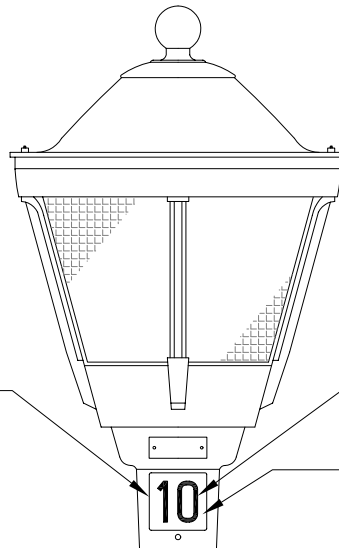


GLASS COBRA HEAD

76 mm x 76 mm
LAMP IDENTIFICATION
LABEL

54 mm TEXT HEIGHT

SEE IDENTIFICATION
LABEL LIST FOR
BACKGROUND COLOUR




POST TOP LUMINAIRE

IDENTIFICATION LABEL LIST			
LAMP WATTAGE	TEXT ON LABEL	TEXT COLOUR	BACKGROUND COLOUR
100W HPS	10	BLACK	GOLD
150W HPS	15	BLACK	GOLD OR GREEN
250W HPS	25	BLACK	GOLD
400W HPS	40	BLACK	GREEN
1000W HPS	X1	BLACK	GOLD

NOTES:

1. ALL LABELS SHALL BE PERMANENT AND WEATHERPROOF.

No.	DESCRIPTION	BY	DATE
		DRAWING TCS-E-705 Date: MAR 2003	
ROADWAY LIGHTING COBRA HEAD & POST TOP LUMINAIRE IDENTIFICATION LABEL			
Prepared By: GJ	Checked By: PMS	Scale: N.T.S.	SECTION E7

E8 MAINTENANCE GUIDELINES

E8.1 Existing Maintenance Procedures

Maintenance of Alberta Transportation's lighting system is presently performed in accordance with agreements with the two primary wire service providers in the province.

Aquila Service Area - Alberta Transportation pays a fixed monthly charge for energy supply and maintenance services. For lighting installed prior to 1995, the maintenance service is limited to the replacement of the bulb, lens and photocell. Maintenance of the pole, (painting and straightening), the luminaire and underground system are NOT included.

Repair and replacement of the pole and/or foundation following a vehicle collision is also not included. For lighting installed after 1995, Alberta Transportation can contract to Aquila at an agreed to fee or hire a local electrical contractor on a case-by-case basis to perform repair and maintenance.

ATCO Electric Service Area - For lighting installed prior to 1995, Alberta Transportation pays a fixed monthly charge per light that includes the bulb, lenses, photocells, lamps and the painting and straightening of poles. Repair and replacement of the pole and/or foundation following a vehicle collision is not included. For lighting installed after 1995, Alberta Transportation can contract with ATCO at an agreed to fee or hire a local electrical contractor on a case-by-case basis to perform repair and maintenance.

TABLE 8.1 - MAINTENANCE RESPONSIBILITIES

Lighting System Installation Year	ATCO Electric Area		Aquila Area	
	ATCO Electric Service	Separate Contractor Service	Aquila Service	Separate Contractor Service
Prior to 1995	All Maintenance services	Damage to poles and bases	Bulb, Lens Photocell	Pole painting, straightening, and replacement Underground system Luminaire repair
1995 to Current		All maintenance services		All maintenance services

The arrangements described above outline the maintenance provisions under the current contracts and agreements with the wire service providers. Appendix L and Appendix M outline some suggestions which Alberta Transportation could incorporate into future maintenance contracts, either as extensions of the existing agreements or requirements for new contracts.

E8.2 General Requirements

Alberta Transportation does not currently have documented maintenance requirements. It is anticipated that these requirements will be developed in the near future and be reflected in a subsequent revision to this section of the manual. A general discussion on some suggested maintenance management procedures are provided in Appendix L.

E8.3 Infrastructure Management

Alberta Transportation does not currently utilize an infrastructure management system. It is anticipated that these requirements will be developed in the near future and be reflected in a subsequent revision to this section of the manual. A general discussion on some suggested infrastructure management procedures are provided in Appendix M.

E8.4 Underground Locating

Underground locating refers to the process of marking buried underground utilities in advance of construction and excavation. The following utility owners in Alberta are shareholder members of the non-profit Alberta One-Call Corporation:

- AltaGas Utilities Inc.
- ATCO Electric Ltd.

- ATCO Gas and Pipelines Ltd.
- BP Canada Energy Company
- The City of Calgary
- The City of Edmonton
- Enmax Corporation
- EPCOR Distribution Inc.
- Federation of Alberta Gas Co-ops Ltd.
- Imperial Oil Resources Limited
- NOVA Gas Transmission Ltd.
- Pembina Pipeline Corporation
- TELUS Communications Inc.
- Aquila Networks Canada (Alberta) Ltd

Over 360 other municipalities and utility owners are members of Alberta One-Call.

The Corporation provides a toll free telephone number (1-800-242-3447) that allows anyone planning to disturb the ground in Alberta to communicate a request to the owners and operators of buried facilities in Alberta, who are members of the Corporation, that the locations of such facilities be marked by the owners prior to excavation. These facilities are marked by either utility employees, or a locate contractor.

Alberta Transportation owns the underground electrical distribution system for a portion of their street lighting system installed since 1995; however, they are not currently a member of the Alberta One-Call Corporation. Until such time as an infrastructure management system is developed, Alberta Transportation will be working with the respective Wire Service Providers to arrange for underground locates.

E9 GLOSSARY OF DEFINITIONS, ACRONYMS, SYMBOLS AND ABBREVIATIONS

Any words implying male persons shall include female persons and corporations. Any words used in the plural include singular and visa versa.

Accommodation: The process by which the eye changes focus from one distance to another.

Adaptation: The process by which the visual system becomes accustomed to more or less light or of a different colour than it was exposed to during an immediately preceding period. It results in a change in the sensitivity of the eye to light.

Arrangement: The repeating pattern of luminaires on a roadway. Usually described as opposite, staggered, one-side, or median mounted.

Average Luminance (L_{av}): The average photometric brightness of a surface expressed in terms of the total luminous flux (lm) actually leaving the surface per unit area (cd/m^2).

Ballast: A device used with an electric-discharge lamp to obtain the necessary circuit conditions (voltage, current and waveform) for starting and operation.

Bikeway: Any road, street, path, or way that in some manner is specifically designated as being open to bicycle travel, regardless of whether such facilities are designated for the

exclusive use of bicycles or are to be shared with other transportation modes.

Brightness: The luminance in terms of subjective sensation as experienced by an individual person.

Candela (cd): The SI Unit of luminous intensity. One candela is one lumen per steradian. Formerly candle.

Candela Per Square Metre (cd/m^2): The SI unit of luminance equal to the uniform luminance of a perfectly diffusing surface emitting or reflecting light at the rate of one lumen per square metre or the average luminance of any surface emitting or reflecting light at that rate.

Disability Glare: Glare resulting in reduced visual performance and visibility. It often is accompanied by discomfort. See Veiling Luminance.

Efficacy: The ratio of the total luminous flux emitted by a lamp to the total lamp power input expressed in lumens per watt.

Efficiency: The ratio of the total luminous flux emitted by a luminaire to that emitted by the bare lamp (%).

Footcandle (fc): The unit of illuminance when the foot is taken as the unit of length. It is the illuminance on a surface, one square foot in area, on which there is a uniformly distributed flux of one lumen, or the illuminance produced on a surface all points of which are at a distance of one foot from a directionally uniform point source of one candela.

Glare: The sensation produced by luminance within the visual field that is sufficiently greater than the luminance to which the eyes

are adapted to cause annoyance, discomfort, or loss in visual performance and visibility.

High Intensity Discharge (HID) Lamps: General group of lamps consisting of mercury, metal-halide and high pressure sodium types.

Highmast Lighting: Illumination of a large area by means of a group of luminaires that are designed to be mounted in fixed orientation at the top of a highmast pole.

High Pressure Sodium (HPS) Lamps: A sodium vapour lamp in which the light is produced by radiation from sodium vapour operating at a partial pressure of about 1.33×10^4 Pa (100 Torr).

Illuminance (E): The density of the luminous flux incident on a surface; it is the quotient of the luminous flux by the area of the surface when the latter is uniformly illuminated (lm/m^2 or lx).

Illuminance (lux or footcandle) meter: An instrument for measuring Illuminance on a plane. Instruments which accurately respond to more than one spectral distribution (colour) are colour corrected. Instruments that accurately respond to more than one spatial distribution of incident flux are cosine corrected. The instrument is comprised of some form of photo detector with or without a filter, driving a digital or analog readout through appropriate circuitry.

Illumination: Commonly used in a qualitative or general sense to designate the act of illuminating or the state of being illuminated.

Intensity: A shortening of the terms luminous intensity and radiant intensity.

Often used for level of illumination or illuminance.

Lamp: A generic term for an artificial source of light.

Lamp Life: The average life of a lamp defined as the total operating hours at which 50 percent of any group of lamps is still operating.

Lamp Lumen Depreciation (LLD) Factor: The multiplier to be used in illuminance calculations to relate the initial rated output of light sources to the anticipated minimum rated output based on the relamping program to be used.

Light Centre (of a lamp): The centre of the smallest sphere that would completely contain the light-emitting element of the lamp.

Light Loss Factor (LLF): A factor used in a lighting calculation after a given period of time and under given conditions. It takes into account temperature and voltage variations, dirt accumulation on luminaire surfaces, lamp lumen depreciation, maintenance procedures, equipment and ballast variations. Formerly called maintenance factor.

Longitudinal Roadway Line (LRL): Any line along the roadway parallel to face of curb or edge of traveled roadway.

Low Pressure Sodium (LPS) Lamps: A sodium vapour lamp in which light is produced by radiation from sodium vapour operating at a partial pressure of 0.1 to 1.5 Pa (approximately 10^{-3} to 10^{-2} Torr).

Lumen (lm): The SI unit of luminous flux equal. Radiometrically, it is determined from the radiant power. Photometrically, it is the luminous flux emitted within a solid angle

(one steradian) by a point source having a uniform luminous intensity of one candela.

Luminaire: A complete lighting unit consisting of a lamp or lamps together with the parts designed to distribute the light, to position and protect the lamps and to connect the lamps to the power supply. Sometimes includes ballasts and photocells.

Luminaire Component Depreciation (LCD)

Factor: The multiplier to be used in Illuminance or luminance calculations to relate the initial flux output of a clean luminaire to the reduced flux output due to permanent dirt accumulation and component deterioration at a particular future time chosen for desirable maintained values. The LCD continues to accumulate throughout the life of the luminaire.

Luminaire Dirt Depreciation (LDD) Factor:

The multiplier to be used in lighting calculations to reduce the initial light level provided by clean, new luminaires to the light level that they will provide due to dirt collection on the luminaires at the time at which it is anticipated that cleaning procedures will be instituted.

Luminance (L): The quotient of the luminous flux at an element of the surface surrounding the point, and propagated in directions defined by an elementary cone containing the given direction, by the product of a solid angle of the cone and area of the orthogonal projection of the element of the surface on a plane perpendicular to the given direction. The luminous flux may be leaving, passing through, and/or arriving at the surface. Note: In common usage the term “brightness” usually refers to the strength of sensation, which results from viewing surfaces, or spaces from which light comes to the eye. This

sensation is determined in part by the definitely measurable luminance defined above and in part by conditions of observation such as the state of adaptation of the eye

Luminance Contrast: The relationship between the luminances of an object and its immediate background.

Luminous Flux (Φ): The time rate of flow of light, expressed in lm.

Luminous Intensity, I (cd): The luminous flux per unit solid angle in a specific direction. Hence it is the luminous flux on a small surface normal to that direction divided by the solid angle (in steradians) that the surface subtends at the source, expressed in cd.

Lux (lx): The SI unit of illuminance, it is the Illuminance on a surface one square metre in area on which there is a uniformly distributed flux of one lumen, or the Illuminance produced at a surface all points of which are at a distance of one metre from a uniform point source of one candela.

Maintenance Factor (MF) or Lumen

Maintenance: A factor formerly used to denote the ratio of the illuminance on a given area after a period of time to the initial illuminance on the same area. Light output from all lamps deteriorates over time at various rates. These must be addressed if the system is to be effective when “minimum” operational levels are attained.

Mounting Height: The vertical distance between the roadway surface and the centre of the apparent light source of the luminaire.

Nadir: The vertical projection directly beneath the apparent light source of a luminaire.

Offset: Distance from face of curb or edge of traveled roadway to traffic hazard (lighting poles, etc.).

Orientation: The angular position of the luminaire around an axis through the light centre and along the 0-180 degree vertical angles. When the zero degree horizontal angle is directed north, orientation is zero degrees. Displacement of the zero degree horizontal end (street side) of the luminaire clockwise is a positive angle. See Roll, Tilt

Reflectance: The ratio of the reflected flux to the incident flux.

Reflector: A device used to redirect the luminous flux from a source by the process of reflection.

Refractor: A device used to redirect the luminous flux from a source primarily by the process of refraction.

Roll: The angular position of the luminaire around axis through the light centre that is an extension of the 0-180 degree horizontal angle. When viewed from the 180 degree angle (mast arm end) rotation clockwise is a positive angle. See tilt, orientation.

Setback: The lateral offset of the pole from face of curb or edge of traveled roadway.

Small Target Visibility (STV): A method of design that determines the visibility level of an array of targets on the roadway. The weighted average of the visibility level of these targets results in the STV.

Spacing: The distance between successive luminaires in any one row as measured along the centreline of the roadway.

Street Side: The horizontal direction that is towards the roadway from the nadir of the luminaire.

Veiling Luminance: A luminance superimposed on the retinal image, which reduces its contrast. It is this veiling effect produced by bright sources or areas in the visual field that results in decreased visual performance and visibility.

Visibility: The quality or state of being perceivable by the eye. In many outdoor applications, visibility is sometimes defined in terms of the distance at which an object can be just perceived by the eye. In indoor and outdoor applications it usually is defined in terms of the contrast or size of a standard test object, observed under standardized view-conditions, having the same threshold as the given object.

Visibility Level (VL): A contrast multiplier to be applied to the visibility reference function or provide the luminance contrast required at different levels of task background luminance to achieve visibility for specified conditions relating to the task and observer.

Visual Angle: The angle subtended by an object or detail at the point of observation. It usually is measured in minutes of arc.

CEC	Canadian Electrical Code
CEMA	Canadian Electrical Manufacturers Association
CSA	Canadian Standards Association
EEMAC	Electrical and Electronic Manufacturers Association of Canada
IESNA	Illuminated Engineering Society of North America
TAC	Transportation Association of Canada
TRANS	Alberta Transportation
WSP	Wire Service Provider

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A	ampere	LDD	luminaire dirt depreciation factor
AADT	average annual daily traffic	LLD	lamp lumen depreciation factor
BCD	bolt circle diameter	LLF	total light loss factor
B/W	breakaway (pole base type)	LPS	low pressure sodium
CU	coefficient of utilization	LRL	longitudinal roadway line
E	illuminance (general)	lux	lumen per m ²
EF	equipment factor	MPD	modified proctor density
Eav	average horizontal illumination on horizontal plane	MH	metal halide
E_{max}	maximum illuminance	Q₀	luminance coefficient (class average)
E_{min}	minimum illuminance	SSR	street side ratio
EV_{min}	minimum vertical illumination at 1.5 m above grade measured in both directions parallel to the main pedestrian flow	STV	small target visibility
fc	footcandle	TRL	transverse roadway line
HID	high intensity discharge	V	volt
HPS	high pressure sodium	VL	visibility level
I	intensity (general)	W	watts
Lav	average luminance	α (alpha)	vertical angle from point of observation
L_{max}	maximum luminance	β (beta)	horizontal angle from point of observation
L_{min}	minimum luminance	δ (delta)	horizontal angle between line of sight and LRL
LV	veiling luminance at the eye	Δ (delta)	increment or change of a variable
LV_{max}	maximum veiling luminance	γ (gamma)	vertical angle from luminaire nadir
LCD	luminaire component depreciation factor	μ (mu)	horizontal angle between line of sight and LRL or 'micro' prefix
		Ω (omega)	solid angle in steradians

Φ (phi)	horizontal angle at a point measured from the TRL at the luminaire nadir or luminous flux in lumens (general)
Φ_T (phi)	lamp test lumens
Φ_i (phi)	lamp initial lumens
ρ (rho)	reflectance (general)
τ (tau)	lamp burning time ratio
θ (theta)	vertical angle at point of observer's eye

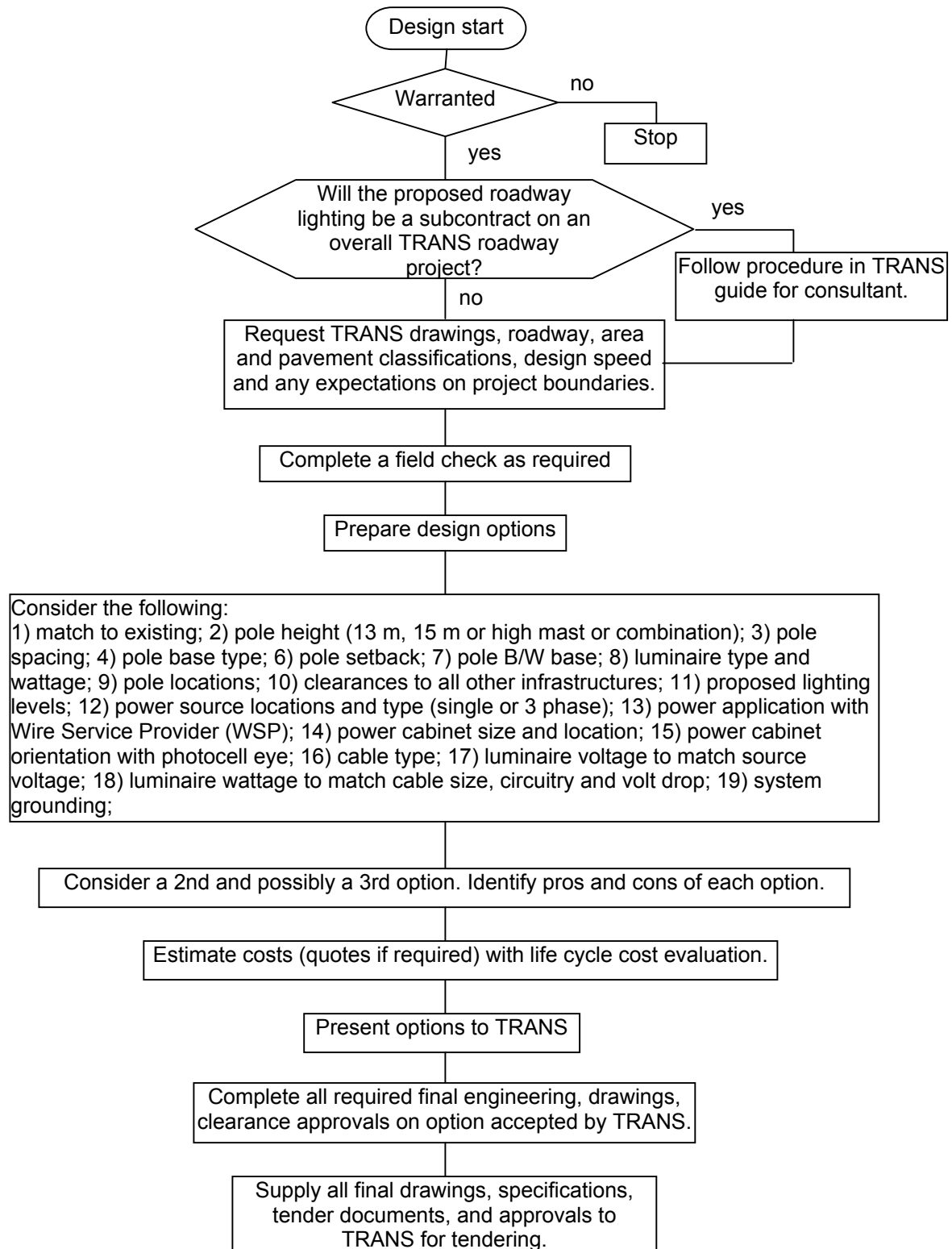
APPENDIX A

HIGHWAY LIGHTING PRODUCTS LIST CATEGORIES

1. Cast-in-place concrete base. (Suitable for all standard davits with listed loadings up to 15.0 m double davits).
2. Pre-cast concrete base. (Suitable for all standard davits with listed loadings up to 15.0 m double davits).
3. Steel screw-in base. (Suitable for all standard davits with listed loadings up to 15.0 m double davits).
4. High mast pole cast-in-place base.
5. Precast Concrete Base for Type A and B Power Distribution Cabinet
6. Galvanized single davit pole – 13.0 m.
7. Galvanized double davit pole – 13.0 m.
8. Galvanized single davit pole – 15.0 m.
9. Galvanized double davit pole – 15.0 m.
10. Standard drop glass HPS luminaire (Type 2 or 3 medium semi-cutoff).
11. Standard flat glass HPS luminaire (Type 2 or 3 medium cutoff).
12. Power cabinet type “A” (single phase 120/240 V with 12 breaker panel, up to 125 A).
13. Power panel cabinet type “B” (single or three phase with 24 breaker panel, up to 200 A).
14. Junction Box (JB) for conduit and wire systems.

APPENDIX B

ROADWAY LIGHTING DESIGN PROCESS FLOWCHART



APPENDIX B (cont'd)

ROADWAY LIGHTING DESIGN CHECKLIST

	YES	NO	
1	<input type="checkbox"/>	<input type="checkbox"/>	Has the appropriate roadway lighting warrant yielded a recommendation for lighting? Type (delineation, partial, full): _____.
2	<input type="checkbox"/>	<input type="checkbox"/>	Does the project include only the addition of, or changes to roadway lighting? (If the lighting is part of a multi discipline TRANS project, full procedural guidelines for consultants exist and must be followed).
3	<input type="checkbox"/>	<input type="checkbox"/>	Has TRANS supplied drawings, the roadway, area and pavement classifications and the design speed for each applicable roadway? Roadway Class: _____ Area Class: _____ Pavement Class (R1~R4): _____ Design Speed: _____ TRANS representative: _____ TRANS sign off on above: _____.
4	<input type="checkbox"/>	<input type="checkbox"/>	Has the scope (extent) of lighting been discussed and finalized with TRANS?
5	<input type="checkbox"/>	<input type="checkbox"/>	Has a site check been completed?
6	<input type="checkbox"/>	<input type="checkbox"/>	Have all special safety requirements been identified? (Pedestrian crossings, railway crossings, complex roadway turns or other).
7	<input type="checkbox"/>	<input type="checkbox"/>	Have logistical constraints been identified? (Severe grades, bridges, match to existing or other).
8	<input type="checkbox"/>	<input type="checkbox"/>	Is the proposed roadway to be lit within an urban centre? Name of urban centre: _____
9	<input type="checkbox"/>	<input type="checkbox"/>	Does the urban centre have any special concerns? City/Town contact name: _____ Phone #: (____) _____ Fax #: (____) _____ E-Mail: _____ Special concerns or requests may include (but not limited to): <ul style="list-style-type: none"> • Light trespass or light pollution concerns; • Local roadway lighting standards; • Aesthetic concerns with pole size, type, colour and/or luminaire size, type, colour. List concerns or requests: _____ _____ _____ _____
10	<input type="checkbox"/>	<input type="checkbox"/>	Has all other infrastructure in the area been identified as to its location, the owner and the required minimal clearance to roadway lighting poles, bases or cables? a) Owner name: _____ Owner phone #: (____) _____ Description of infrastructure: _____ Location of infrastructure: _____ Required clearance to infrastructure: _____ b) Owner name: _____ Owner phone #: (____) _____ Description of infrastructure: _____ Location of infrastructure: _____ Required clearance to infrastructure: _____

APPENDIX B (cont'd)

ROADWAY LIGHTING DESIGN CHECKLIST

	YES	NO	
11	<input type="checkbox"/>	<input type="checkbox"/>	If there is existing roadway lighting near the project area, has it been reviewed and existing lighting levels calculated?
12	<input type="checkbox"/>	<input type="checkbox"/>	Have the correct required light levels, light loss factor and calculation grid been identified?
13	<input type="checkbox"/>	<input type="checkbox"/>	Have pole height and luminaire size and type, and the use of B/W bases been investigated for theoretical pole configuration, setback and spacing to yield the required light levels for option 1?
14	<input type="checkbox"/>	<input type="checkbox"/>	Have pole base type, wiring type and power cabinet size and location been identified?
15	<input type="checkbox"/>	<input type="checkbox"/>	Have other applicable options also been investigated?
16	<input type="checkbox"/>	<input type="checkbox"/>	Has the WSP application process been initiated?
17	<input type="checkbox"/>	<input type="checkbox"/>	Has a pre-design report been completed including a discussion of each option relative to safety, life cycle cost evaluation, overall efficiency and aesthetics?
18	<input type="checkbox"/>	<input type="checkbox"/>	Have the standard pole placement drawings in the guide been used to identify standard critical pole placements?
19	<input type="checkbox"/>	<input type="checkbox"/>	Has a conceptual drawing for the recommended option been completed?
20	<input type="checkbox"/>	<input type="checkbox"/>	Has TRANS accepted one of the outlined options? Option description: _____ TRANS representative: _____ TRANS sign off: _____
21	<input type="checkbox"/>	<input type="checkbox"/>	Has a final design been completed including confirmation of all required clearance approvals to each pole while still maintaining the required light levels?
22	<input type="checkbox"/>	<input type="checkbox"/>	Has a suitable power cabinet size, type and location been identified, including addressing photo eye orientation and control?
23	<input type="checkbox"/>	<input type="checkbox"/>	Has a suitable wiring method been specified that will support calculated voltage drops to all circuits?
24	<input type="checkbox"/>	<input type="checkbox"/>	Have grounding requirements been identified?
25	<input type="checkbox"/>	<input type="checkbox"/>	Have final drawings according to drafting standards been completed?
26	<input type="checkbox"/>	<input type="checkbox"/>	Have all required TRANS specifications for the project been completed?
27	<input type="checkbox"/>	<input type="checkbox"/>	Have the drawings and specifications been submitted for tender?

APPENDIX B (cont'd)

DESIGNER INITIAL SITE CHECKLIST

1. Use warrant guidelines to determine if and how much lighting is warranted.
2. Is there existing lighting near the proposed lighting location? If YES, determine existing pole spacing, height, type, finish, luminaire type, wattage, and road width. Calculate existing lighting levels.
3. Identify all other infrastructure and ownership in the proposed area that may conflict with any proposed roadway lighting, including road accesses, overhead (O/H) or underground (U/G) power lines, O/H or U/G communication lines, U/G high pressure or low pressure gas lines, U/G water lines (domestic, fire or irrigation), U/G sanitary, storm sewer lines, etc.
4. Identify any safety or other relevant issues (location of roadway signs, flashing pedestrian crossing, traffic signals, railway crossings, underpass or tunnel lighting, etc.)
5. Identify any “no pole” areas, such as roadsides with severe elevation changes or other lighting inhibiting factors (example: trees).
6. Identify prospective locations and routing for roadway lighting poles, cable trenching, power cabinet placement and closest power source.

APPENDIX C

Life Cycle Cost Evaluation

Description of Design Option:

Part 1. Design option estimated capital cost:

\$ _____

Part 2. Maintenance estimated cost:

	Proposed number of locations in project	Average material cost (per unit)	Estimated labour cost to replace	Failure rate in 25 years	25 year life cycle cost (\$)
Lamps	a	b	c	4 year	$a(b+c)25/4$
Luminaires	e	f	g	40 %	$e(f+g)0.4$
Glass on luminaires	m	n	p	60 %	$m(n+p)0.6$
Pole + base	s	t	u	10 %	$s(t+u)0.1$
Sub Total:					

\$ _____

Part 3. Estimated energy cost:

Proposed number of luminaires in the project	Luminaire wattage (kW)	Average operating hours each year	Electric rate (\$/kWh)	Estimated energy cost in 25 years
w	x	4200	z	$w*x*y*z*25$

\$ _____

Total 25-year life cycle estimated comparable cost:
(Part 1+Part 2+Part 3)

\$ _____

APPENDIX C (cont'd)

Life Cycle Cost Example (dependant on travel time)

Description of Design Option: 10x250W HPS on single davits.

Part 1. Design option estimated capital cost:

\$40,000

Part 2. Maintenance estimated cost:

	Proposed number of locations in project	Average material cost (per unit)	Estimated labour cost to replace	Failure rate in 25 years	25 year life cycle cost (\$)
Lamps	10	\$ 20	\$ 50	4 years	$10 \times (20 + 50) \times 25/4 = \4375
Luminaires	10	\$ 250	\$ 400	40%	$10 \times (250 + 400) \times 40\% = \2600
Glass on luminaires	10	\$ 50	\$ 200	60%	$10 \times (50 + 200) \times 60\% = \1500
Pole + base	10	\$ 2000	\$ 2000	10%	$10 \times (2000 + 2000) \times 10\% = \4000
Sub Total:					<u>\$12,475</u>

\$12,475

Part 3. Estimated energy cost:

Proposed number of luminaires in the project	Luminaire wattage (kW)	Average operating hours each year	Electric rate (\$0.05/kWh is an example only, actual will change)	Estimated energy cost in 25 years
10	0.295	4200 hr	\$0.05/kWh	$10 \times 0.295 \times 4200 \times 0.05 \times 25 = \$15,488$

\$15,488**Total 25-year life cycle estimated comparable cost:
(Part 1+Part 2+Part 3)****\$67,963**

APPENDIX D

AIRPORT CLEARANCES

Approximate "layman term" definitions are as follows:

Definitions:

- 1) A precision approach class airport runway has a complete navigational guidance system which allows pilots to make precision approaches with instruments.
- 2) A non-precision approach runway has one or more navigational aids to allow pilots to land using instrument approaches.
- 3) A non-instrument approach runway uses Visual Flight Rules only (VFR) (a day VFR will not have lights whereas a day/night VFR will have lights.)
- 4) The threshold is the actual end of the landing surface (paved or other)
- 5) The inner edge is like a border around the runway that defines where the obstacle limitation surface meets the ground and where the sloping surfaces begin.

A simplified example calculation is as follows:

In discussions with the airport manager, he states that the runway length is 1000 m and will remain that way indefinitely.

- a) This makes the runway a code 2 using Table 1-1.

PART 1 TABLE 1-1

TABLE 1-1 COPIED FROM:
AERODROME STANDARDS &
RECOMMENDED PRACTICES
MANUAL PAGE 1-7.

Code no. #	AEROPLANE REFERENCE FIELD LENGTH
1	LESS THAN 800 m
2	800 m UP TO BUT NOT INCLUDING 1200 m
3	1200 m UP TO BUT NOT INCLUDING 1800 m
4	1800 m AND OVER

Further information concludes that there are no navigational aids "that allow pilots to land using instrument approaches", and that there are no plans to install any in the conceivable future.

- b) This defines a non-instrument type runway and the corresponding column in Table 4-1 can be used to determine the "obstacle limitation surfaces".

APPENDIX D (cont'd)

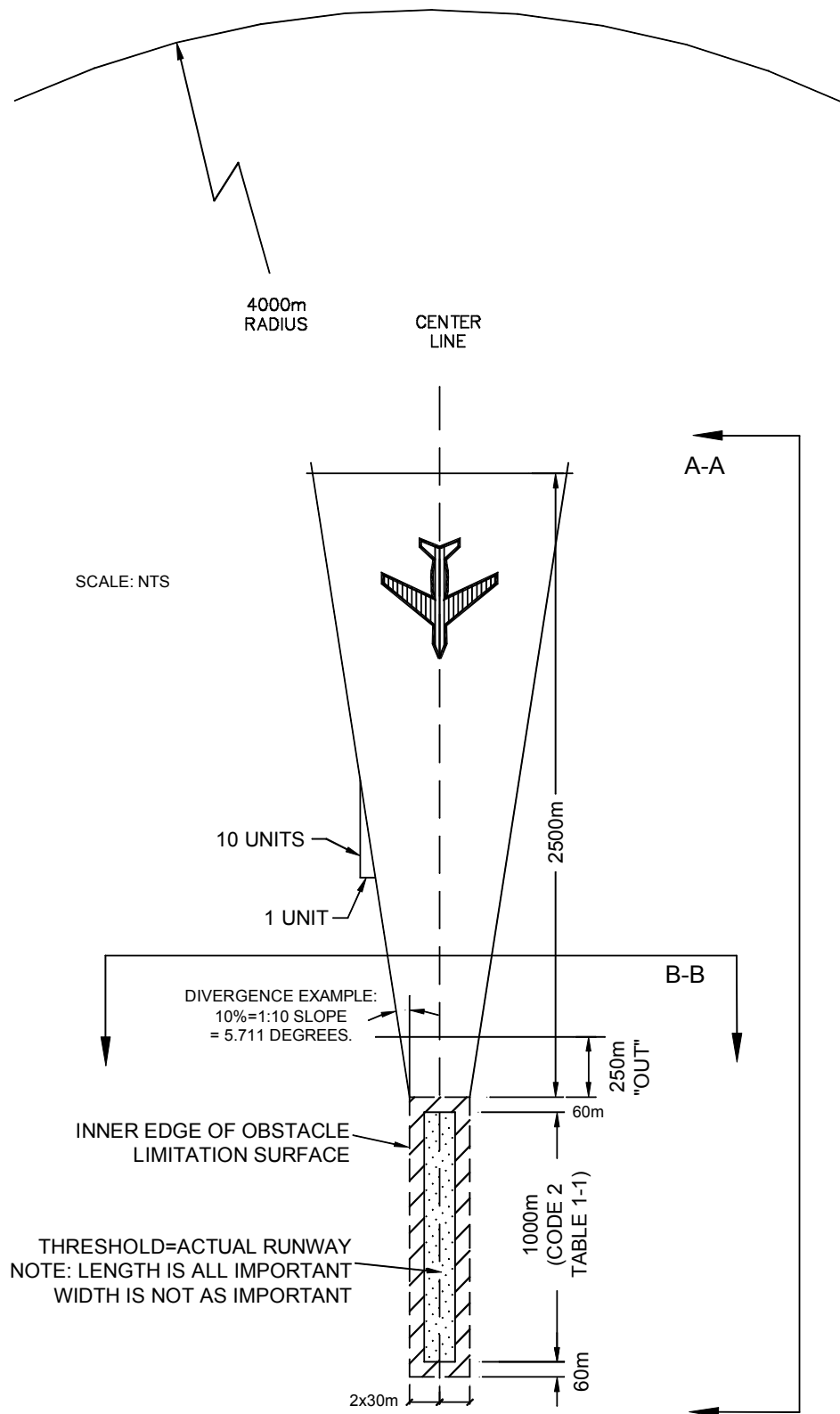
TABLE 4-1TABLE 4-1 COPIED FROM: AERODROME
STANDARDS & RECOMMENDED PRACTICES
MANUAL PAGE 4-5.

RUNWAY TYPE									
SURFACES & DIMENSIONS	NON-INSTRUMENT				NON-PRECISION APPROACH		PRECISION APPROACH		
CODE NUMBERS FROM TABLE 1-1									
OUTER SURFACE	1	2	3	4	1&2	3	4	1&2	3&4
HEIGHT	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m
RADIUS	4000 m	4000 m	4000 m	4000 m	4000 m	4000 m	4000 m	4000 m	4000 m
APPROACH SURFACE									
INNER EDGE-CENTERLINE	30 m	30 m	45 m	75 m	45 m	75 m	150 m	75 m	150 m
INNER EDGE-THRESHOLD	30 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m
DIVERGENCE	10%	10%	10%	10%	10%	15%	15%	15%	15%
LENGTH	2500 m	2500 m	2500 m	2500 m	2500 m	3000 m	3000 m	15000 m	15000 m
SLOPE	1:20	1:25	1:40	1:40	1:30	1:40	1:40	1:40	1:50
TRANSITION SURFACE									
SLOPE	1:5	1:5	1:7	1:7	1:7	1:7	1:7	1:7	1:7

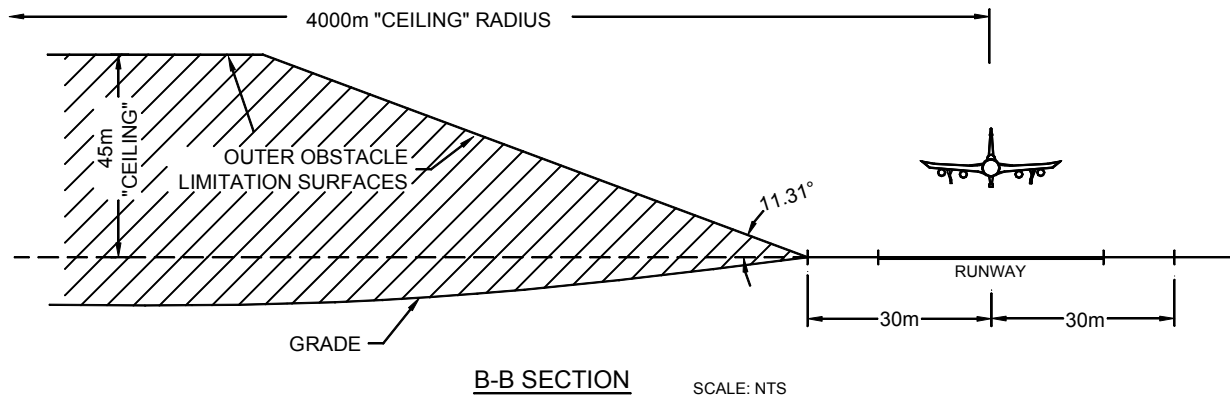
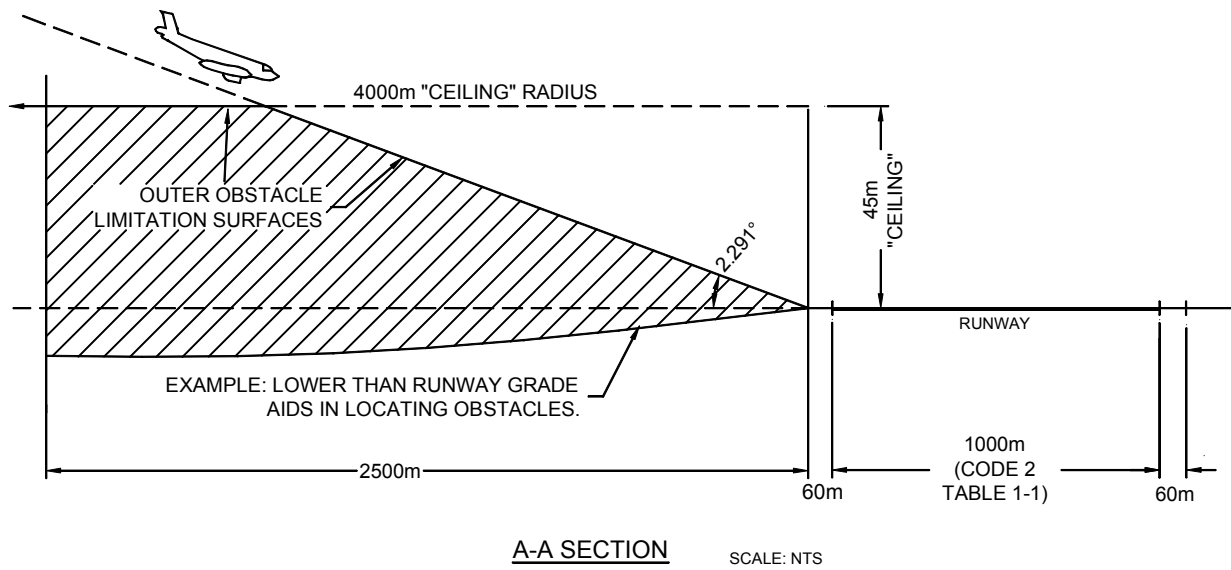
DIVERGENCE vs SLOPE vs DEGREES									
DIVERGENCE	2.0%	2.5%	3.3%	4.0%	5.0%	10%	14.3%	15%	20%
SLOPE	1:50	1:40	1:30	1:25	1:20	1:10	1:7	1:6.7	1:5
DEGREES	1.146	1.432	1.909	2.291	2.862	5.711	8.130	8.531	11.31

Using the values above, draw a diagram showing all proposed objects with respect to the limiting surface.

APPENDIX D (cont'd)



APPENDIX D (cont'd)



APPENDIX E

CLEARANCE TO OTHER INFRASTRUCTURE CHECKLIST

	YES	NO	
1	<input type="checkbox"/>	<input type="checkbox"/>	<p>Are there any roadway accesses within the project boundaries? (Eg. Driveways or turnoffs). If YES, what is the minimum clearance to a roadway lighting pole base? _____ (m).</p> <p>Access owner: _____</p> <p>Contact phone #: (____) _____.</p> <p>What are the procedures required to cross the access? _____</p>
2	<input type="checkbox"/>	<input type="checkbox"/>	<p>Are there any overhead high voltage power lines within the project boundaries? If YES, what are the required minimum clearances to a roadway lighting pole from the local electric utility (WSP): _____ (m)</p> <p>Local electric utility name: _____</p> <p>Contact phone #: (____) _____.</p>
3	<input type="checkbox"/>	<input type="checkbox"/>	<p>Are there any underground high voltage power lines within the project boundaries? If YES, what are the required minimum clearances from the powerline to</p> <p>i). Roadway lighting pole base: _____ (m).</p> <p>ii) Underground lighting cable: _____ (m)</p> <p>Local electric utility name: _____</p> <p>Contact phone #: (____) _____.</p> <p>What are the procedures required to cross the U/G HV? _____</p>
4	<input type="checkbox"/>	<input type="checkbox"/>	<p>Are there any overhead or underground telephone company lines within the project boundaries? If YES, what are the required minimum clearances from the telephone line to</p> <p>i). Roadway lighting pole or base: _____ (m).</p> <p>ii) Underground lighting cable: _____ (m)</p> <p>Local phone company name: _____</p> <p>Contact telephone #: (____) _____.</p> <p>What are the procedures required to cross the U/G Tel? _____</p>
5	<input type="checkbox"/>	<input type="checkbox"/>	<p>Are there any overhead or underground "other" communications lines within the project boundaries? If YES, what are the required minimum clearances from the communication line to</p> <p>i). Roadway lighting pole or base: _____ (m).</p> <p>ii) Underground lighting cable: _____ (m)</p> <p>Local communications utility name: _____</p> <p>Contact phone #: (____) _____.</p> <p>What are the procedures required to cross the U/G comm? _____</p>

APPENDIX E (cont'd)

6	<input type="checkbox"/>	<input type="checkbox"/>	<p>Are there any buried low pressure gas lines (< 100 PSI or 689 kPa) within the project boundaries? If YES, what are the required minimum clearances from the gas line to</p> <p>i). Roadway lighting pole base: _____ (m). ii) Underground lighting cable: _____ (m)</p> <p>Local gas utility name: _____ Contact phone #: (____) _____.</p> <p>What are the procedures required to cross the U/G gas? _____</p>
7	<input type="checkbox"/>	<input type="checkbox"/>	<p>Are there any buried high pressure gas lines (or other) within the project boundaries? If YES, what are the required minimum clearances from the high pressure gas line to</p> <p>i). Roadway lighting pole base: _____ (m). ii) Underground lighting cable: _____ (m)</p> <p>High pressure line owner: _____ Contact phone #: (____) _____.</p> <p>Will a crossing agreement for any cable crossings be required? _____</p> <p>What are the procedures required to cross the HPG? _____</p>
8	<input type="checkbox"/>	<input type="checkbox"/>	<p>Are there any buried water lines within the project boundaries? If YES, what are the required minimum clearances from the water line to</p> <p>i). Roadway lighting pole base: _____ (m). ii) Underground lighting cable: _____ (m)</p> <p>Water line owner name: _____, Contact phone #: (____) _____.</p> <p>What are the procedures required to cross the U/G line? _____</p>
9	<input type="checkbox"/>	<input type="checkbox"/>	<p>Are there any buried sanitary or storm sewer lines within the project boundaries? If YES, what are the required minimum clearances from the sanitary or storm sewer line to</p> <p>i). Roadway lighting pole base: _____ (m). ii) Underground lighting cable: _____ (m)</p> <p>Line owner name: _____ Contact phone #: (____) _____.</p> <p>What are the procedures required to cross the U/G line? _____</p>
10	<input type="checkbox"/>	<input type="checkbox"/>	<p>Is there an expected line assignment procedure for cables within the project area if the project is within a municipality?</p> <p>What is the typical setback for lighting cables from the edge of road or face of curb? _____</p>
11			<p>Municipality: _____ Contact phone #: (____) _____</p>

APPENDIX F

POWER (TRANSFORMER) APPLICATION PROCEDURE WITH WIRE SERVICE PROVIDER (WSP)

	YES	NO	
1	<input type="checkbox"/>	<input type="checkbox"/>	Has the WSP been identified? Name of WSP: _____.
2	<input type="checkbox"/>	<input type="checkbox"/>	Has a request for power been submitted to the WSP for the required roadway lighting services? Date of request: _____.
3	<input type="checkbox"/>	<input type="checkbox"/>	Did the request include all the info required by the WSP? Owner: <u>Alberta Transportation</u> Project location description *: _____. Type of service: <u>Single phase, 120/240 V</u> Or other: _____. Service size: <u>125 A</u> Or other: _____.
4	<input type="checkbox"/>	<input type="checkbox"/>	Was the preferred location of the power service cabinet(s) indicated on the plans provided to the WSP?
5	<input type="checkbox"/>	<input type="checkbox"/>	Is a standard panel suitable to meet the available fault levels at the power cabinet location(s)? Estimated fault level at power cabinet location: _____.
6	<input type="checkbox"/>	<input type="checkbox"/>	Will the WSP allow the meter base in the power cabinet to be jumpered and provide a monthly flat rate cost to TRANS for each luminaire wattage used? Designed luminaire wattage: _____. Monthly flat rate from WSP: _____.
7	<input type="checkbox"/>	<input type="checkbox"/>	Was a time estimate given by the WSP to deliver a cost estimate? Expected date: _____.
8	<input type="checkbox"/>	<input type="checkbox"/>	Was a time estimate given by the WSP to complete construction of the power service to the power cabinet location(s)? Expected date: _____.
9	<input type="checkbox"/>	<input type="checkbox"/>	Is there a financial contribution required by TRANS to have the WSP construct the power service(s)? Cost: _____ GST not applicable
10	<input type="checkbox"/>	<input type="checkbox"/>	Is there a WSP financial contribution as an investment in the lighting load? Amount: _____.
11	<input type="checkbox"/>	<input type="checkbox"/>	Was a service contract from the WSP forwarded to TRANS for signing? Date: _____.
12	<input type="checkbox"/>	<input type="checkbox"/>	Was the signed service contract sent back to the WSP? Date: _____.
13	<input type="checkbox"/>	<input type="checkbox"/>	Is there a confirmed date that the WSP will have the power service(s) constructed to the power cabinet location(s)? Date: _____.

* Note that the **project location description** must remain the same throughout the project and into billing. Prior to submitting a description to the WSP, the lighting designer shall confirm the description with TRANS Operations Manager. The same description shall be used when applying for energization of the power services and when obtaining a site ID number.

APPENDIX G

**POWER (ENERGY) APPLICATION PROCEDURE
WITH ALBERTA TRANSPORTATION'S RETAILER OF CHOICE**

	YES	NO	
1	<input type="checkbox"/>	<input type="checkbox"/>	Has the lighting contractor completed the installation of all bases, poles, lights, wiring and power cabinets?
2	<input type="checkbox"/>	<input type="checkbox"/>	Is there an approved inspection tag on the power cabinets?
3	<input type="checkbox"/>	<input type="checkbox"/>	Has a site ID number with a TRANS confirmed <u>project location description</u> been obtained? Site ID: _____. Project Location Description: _____.
4	<input type="checkbox"/>	<input type="checkbox"/>	Was a single site ID number given by the WSP for all the lights at the project location? If there are multiple site ID numbers, list them below: _____ _____ _____.
5	<input type="checkbox"/>	<input type="checkbox"/>	Has the TRANS energy retailer of choice been identified? Retailer: _____.
6	<input type="checkbox"/>	<input type="checkbox"/>	Has a completed application form been faxed to the retailer? Fax #: _____.
7	<input type="checkbox"/>	<input type="checkbox"/>	Has the completed application form been faxed to TRANS? Fax # (780) 422-5426 .
8	<input type="checkbox"/>	<input type="checkbox"/>	Has an amending agreement from the retailer for the new lights been forwarded to TRANS? Date: _____.
9	<input type="checkbox"/>	<input type="checkbox"/>	Has the TRANS signed agreement been sent back to the retailer? Date: _____.
10	<input type="checkbox"/>	<input type="checkbox"/>	Has the retailer notified the WSP of the energization request? Expected energization date: _____.
11	<input type="checkbox"/>	<input type="checkbox"/>	Has TRANS received a copy of the amending agreement to confirm that the account has been enrolled?
12	<input type="checkbox"/>	<input type="checkbox"/>	Has the lighting contractor confirmed that the site is energized and available for commissioning?

APPENDIX H
SITE INSPECTION FORM COVER SHEET

Inspection Date: _____

Project Name: _____

Project Number: _____

Project Location Description: _____

Design Consultant Company: _____

Designer Name: _____

Designer Phone #: () _____

Construction Company: _____

Lead Construction Name: _____

Company Phone #: () _____

APPENDIX H (cont'd)

SITE INSPECTION SHEET # _____

Location Description: _____

	YES	NO	
1	<input type="checkbox"/>	<input type="checkbox"/>	Are all bases installed as per survey locations?
2	<input type="checkbox"/>	<input type="checkbox"/>	Are all bases installed as per designed locations? (Designed = Construction drawings + Engineer requested changes)
3	<input type="checkbox"/>	<input type="checkbox"/>	Are all bases installed as per specifications? <i>Contractor Initials</i> _____.
4	<input type="checkbox"/>	<input type="checkbox"/>	Are all B/W bases installed as per specifications? <i>Contractor Initials</i> _____.
5	<input type="checkbox"/>	<input type="checkbox"/>	Was the trench excavated in all locations to the specified depth? <i>Contractor Initials</i> _____.
6	<input type="checkbox"/>	<input type="checkbox"/>	Was all sand bedding and sand cover in all locations installed as per specifications? <i>Contractor Initials</i> _____.
7	<input type="checkbox"/>	<input type="checkbox"/>	Are all cables installed as per design? <i>Contractor Initials</i> _____.
8	<input type="checkbox"/>	<input type="checkbox"/>	Was a warning tape installed in all locations as per specifications? <i>Contractor Initials</i> _____.
9	<input type="checkbox"/>	<input type="checkbox"/>	Was all required backfilling in all locations compacted as per specifications? <i>Contractor Initials</i> _____.
10	<input type="checkbox"/>	<input type="checkbox"/>	Was the backfill suitable as per specifications? (No snow or ice or vegetation or silty soil or sharp objects etc.). <i>Contractor Initials</i> _____.
11	<input type="checkbox"/>	<input type="checkbox"/>	Have all clearances to other infrastructure remained sufficient?
12	<input type="checkbox"/>	<input type="checkbox"/>	Are all poles installed as per design?
13	<input type="checkbox"/>	<input type="checkbox"/>	Are all poles plumb?
14	<input type="checkbox"/>	<input type="checkbox"/>	Are all luminaires installed as per specifications?

APPENDIX I

COMMISSIONING SHEET # _____
For a **Roadway Lighting Pole**

Pole #: _____ - _____ - _____ - _____ - _____

	YES	NO	
1	<input type="checkbox"/>	<input type="checkbox"/>	Is the base the correct type?
2	<input type="checkbox"/>	<input type="checkbox"/>	Is the base installed in the correct location along the roadway?
3	<input type="checkbox"/>	<input type="checkbox"/>	Is the base installed with the correct setback?
4	<input type="checkbox"/>	<input type="checkbox"/>	Is the base properly installed at the correct elevation?
5	<input type="checkbox"/>	<input type="checkbox"/>	Is the base properly installed aesthetically (concrete finish or other)?
6	<input type="checkbox"/>	<input type="checkbox"/>	Is the pole installed plumb?
7	<input type="checkbox"/>	<input type="checkbox"/>	Is the pole installed as per design with or without a Break Away (B/W) base?
8	<input type="checkbox"/>	<input type="checkbox"/>	Is the pole the correct size as per design (13 m or 15 m or high mast)?
9	<input type="checkbox"/>	<input type="checkbox"/>	Is the pole the correct finish as per design? (Galvanized or powder coated)?
10	<input type="checkbox"/>	<input type="checkbox"/>	Is the pole installed in the correct orientation?
11	<input type="checkbox"/>	<input type="checkbox"/>	Is the pole handhole facing in the designed direction?
12	<input type="checkbox"/>	<input type="checkbox"/>	Is the pole correctly numbered?
13	<input type="checkbox"/>	<input type="checkbox"/>	Is the wiring to the luminaire fused properly?
14	<input type="checkbox"/>	<input type="checkbox"/>	Are the cables terminated properly, including grounding?
15	<input type="checkbox"/>	<input type="checkbox"/>	Are the cables within the handhole the correct size, type and quantity?
16	<input type="checkbox"/>	<input type="checkbox"/>	Does the trench line appear compacted and neatly finished?
17	<input type="checkbox"/>	<input type="checkbox"/>	Is the luminaire wattage label shown and correct?
18	<input type="checkbox"/>	<input type="checkbox"/>	Does the luminaire operate as per designed controls?
19	<input type="checkbox"/>	<input type="checkbox"/>	Does the pole location have an individual site ID#? If yes, site ID# _____, from WSP (name): _____.

APPENDIX J

COMMISSIONING SHEET # _____
For a Power Supply Cabinet

Location Description: _____

	YES	NO	
1	<input type="checkbox"/>	<input type="checkbox"/>	Is the power cabinet located correctly as per design?
2	<input type="checkbox"/>	<input type="checkbox"/>	Is the power cabinet facing correctly as per design?
3	<input type="checkbox"/>	<input type="checkbox"/>	Is the power cabinet plumb?
4	<input type="checkbox"/>	<input type="checkbox"/>	Is the power cabinet base as per design?
5	<input type="checkbox"/>	<input type="checkbox"/>	Is the power cabinet base installed correctly?
6	<input type="checkbox"/>	<input type="checkbox"/>	Is the power cabinet complete with all parts as per design? (Panel size, type, number of circuits, wiring, contactors, service plug, service light, photo eye, HOA switch, etc.)
7	<input type="checkbox"/>	<input type="checkbox"/>	Is the meter jumpered?
8	<input type="checkbox"/>	<input type="checkbox"/>	Is the inspection tag installed?
9	<input type="checkbox"/>	<input type="checkbox"/>	Is the photo eye facing north?
10	<input type="checkbox"/>	<input type="checkbox"/>	Is the photo eye wired to provide a normally closed operation? (Eye failure = lights on)
11	<input type="checkbox"/>	<input type="checkbox"/>	Are all cables properly terminated?
12	<input type="checkbox"/>	<input type="checkbox"/>	Are the correct numbers of circuits and wire sizes as per design?
13	<input type="checkbox"/>	<input type="checkbox"/>	Is each circuit operational?
14	<input type="checkbox"/>	<input type="checkbox"/>	Is the panel index correctly marked?
15	<input type="checkbox"/>	<input type="checkbox"/>	Is the laminated wiring diagram with circuits labeled present and correct?
16	<input type="checkbox"/>	<input type="checkbox"/>	Does the power cabinet location have an individual site ID #? If yes, site ID# _____, from WSP (name): _____.
17	<input type="checkbox"/>	<input type="checkbox"/>	Is the voltage at the end of each circuit sufficient?

COMMISSIONING SHEET # _____
For **Miscellaneous Items**

[illegible]

APPENDIX L

Maintenance Guidelines

Alberta Transportation does not currently have documented maintenance requirements. It is anticipated that these requirements will be developed in the near future and be reflected in a subsequent revision to this manual. A general discussion on some suggested maintenance management procedures is provided below.

Equipment to be Maintained

The policies, standards and procedures shall apply to the equipment in the table below. References can be made to the appropriate appendix for drawings and specifications of equipment.

SYSTEM	EQUIPMENT
Power Distribution	<ul style="list-style-type: none"> • Junction boxes and Vaults • Service and control panels • Overhead conductors and support cables • Underground conduit and cable • Underground wiring and splices
Lighting	<ul style="list-style-type: none"> • Roadway lighting luminaires and lamps • Sign lighting luminaires and lamps • High mast lighting luminaires and lamps • Wall mount/Underpass luminaires and lamps

Contractor Qualifications

Alberta Transportation shall only permit Contractors with an acceptable level of qualification and expertise to perform maintenance and repair work on the Alberta Transportation roadway lighting systems.

Contractors wishing to perform maintenance and repair on these systems must make application for and receive pre-qualification status from Alberta Transportation. The pre-qualification procedure and minimum contractor requirements will be developed at a future date.

Maintenance Documentation

The Maintenance Contractor shall document all maintenance and repair issues in the manner prescribed by Alberta Transportation. The documentation procedures and the standard reporting formats required by Alberta Transportation will be developed at a future date.

Safety Documentation

Safety problems related to the equipment covered by this manual shall be reported to Alberta Transportation. The report shall include the following information:

- A detailed description of the problem, including clear identification of the equipment and conditions involved.
- An indication of the urgency and severity of the problem.
- Detailed description of the immediate resolution of the problem or for the isolation of the problem if a resolution is not immediately available.
- An acknowledgement requirement from Alberta Transportation. The recipient of the report may be required to acknowledge its receipt depending on the severity of the problem.

APPENDIX L (cont'd)**Discontinued Equipment**

A report shall be submitted to Alberta Transportation if equipment is discontinued (taken out of service). This report shall include the following information:

- Reason for discontinuation of the equipment.
- Scheduling for the removal of equipment from service.
- Notice if the equipment is no longer being supportable with consumable items and spare parts.
- Hazardous products that may be contained within or related to equipment. This also includes any specific environmental requirements related to disposal and any special handling or shipment requirements.

Maintenance Records

Alberta Transportation shall keep maintenance records for a period of seven years. This is consistent with the record retention requirements and obligations under the Freedom of Information Act.

Preventive maintenance records shall be kept for all installed equipment. These records could include:

- Identification of equipment inventory.
- Sequence of operation of the equipment.
- Detailed description of preventive maintenance.
- Scheduled date and frequency of maintenance.
- Date and indication of completed maintenance.

Records shall be kept of all operational problems, maintenance problems, and

responses and corrective maintenance. These records shall include:

- Date, time of notification, and description of the problem.
- Identification of equipment inventory.
- Date and description of the response.
- Date and description of completed maintenance.

The following equipment shall have a site logbook or maintenance card:

- Service and control cabinets and panels.
- Railway crossing warning signs.
- Special crosswalk signs.

The logbook or maintenance card shall record the following information:

- Date and time of each service visit.
- A summary of the maintenance performed or the reason for the visit.
- Elapsed run time of the equipment or duration of test where applicable.
- Identification of the Maintenance Contractor who performed the maintenance.

Quality Control

Quality control is the responsibility of the Maintenance Contractor. Quality control relating to all maintenance and repair work is key in assuring that the Alberta Transportation roadway lighting system functions, and will continue to function in a safe and consistent manner. Maintenance Contractor quality control requirements will be developed at a future date.

Quality Assurance

Equipment shall be inspected on a periodic basis to ensure compliance with standards

APPENDIX L (cont'd)

and the quality of workmanship. The periodic inspection schedule requirements will be developed at a future date.

Inspections shall be done by Alberta Transportation qualified or pre-qualified personnel.

Inspections shall include:

- Physical examination of the equipment.
- Operation of equipment through all sequences or modes.
- A written report to Alberta Transportation.

Exception reporting:

- A list of the outstanding corrective and preventive maintenance items not completed within the times stated in the individual electrical maintenance standards shall be prepared annually.
- The list shall include reasons for not completing the maintenance.
- Copies of the exception report shall be sent to the Alberta Transportation department responsible for electrical maintenance.

Corrective Maintenance

Corrective maintenance shall be performed to ensure that the equipment will perform at the required level of functionality until at least the next planned maintenance.

Corrective maintenance, in addition to the requirements of this manual, shall be performed when deemed necessary by Alberta Transportation.

Corrective maintenance shall be evaluated and performed in accordance with the procedure to be developed at a future date.

Scheduling Corrective Maintenance

When notified of an emergency condition, Alberta Transportation authorized personnel shall respond immediately to eliminate the condition.

Workers shall be dispatched within one hour of notification of an emergency if required to place the equipment or site in a safe condition.

Workers shall continue the corrective maintenance activity until emergency conditions have been rectified.

When notified of a non-emergency condition, Alberta Transportation authorized personnel shall start corrective maintenance within the response time specified in the corrective maintenance tables (which will be developed at a future date).

Temporary Repairs

Temporary repairs may be done if conditions do not allow for full corrective maintenance to be completed.

Preventative Maintenance

Preventive maintenance shall be conducted regularly to promote the serviceability and longevity of the equipment.

Specific preventive maintenance requirements for the equipment are detailed in the Maintenance Procedures which will be developed at a future date. These requirements represent the Alberta Transportation minimum preventive maintenance standards for the equipment. Preventive maintenance shall be performed as detailed in these requirements. Unsafe conditions detected during preventive maintenance shall be repaired immediately.

Conditions detected that affect operations or public safety, but are not part of the preventative maintenance procedure, shall be

APPENDIX L (cont'd)

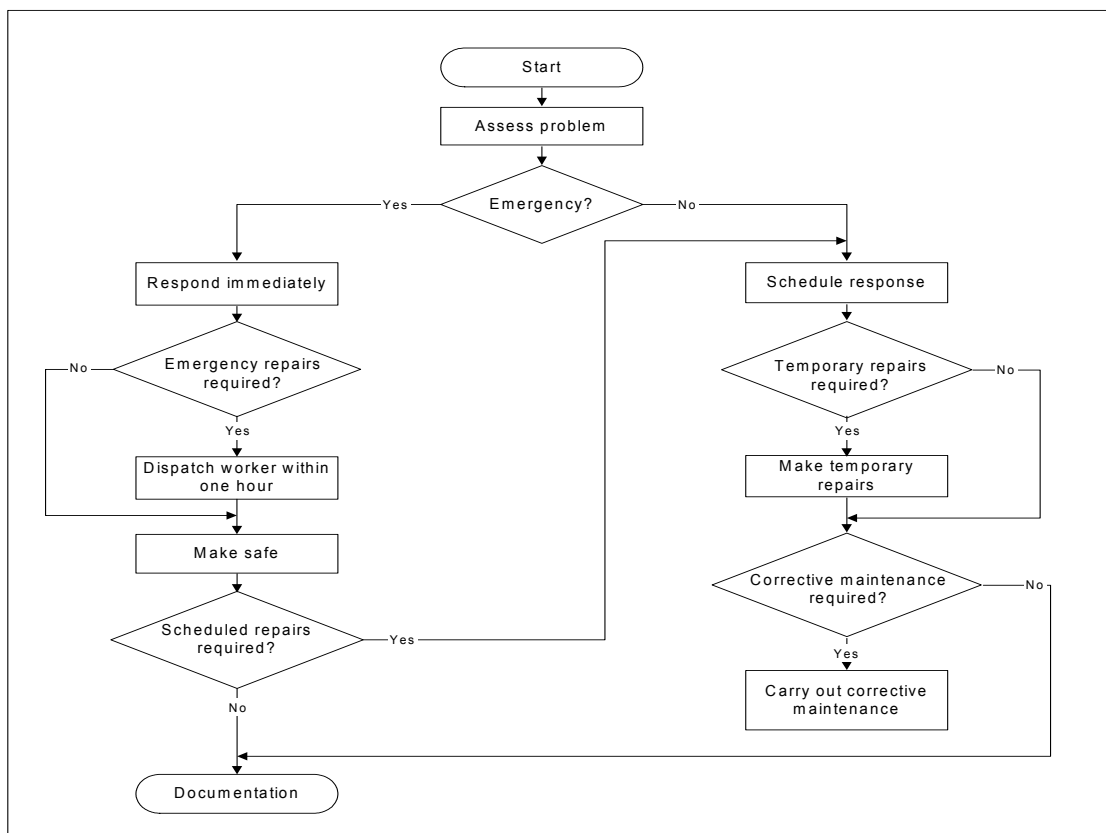
reported immediately to Alberta Transportation.

Corrective maintenance that is not completed at the time of the preventive maintenance shall be scheduled according to the priorities of corrective maintenance.

Preventive maintenance, in addition to the requirements of this manual, shall be performed when deemed necessary by Alberta Transportation authorized personnel.

Scheduling Preventative Maintenance

Preventative maintenance shall be performed in accordance with the schedule requirements (which will be developed at a future date).

**CORRECTIVE MAINTENANCE EVALUATION**

APPENDIX M

Infrastructure Management

Alberta Transportation does not currently utilize an infrastructure management system. It is anticipated that these requirements will be developed in the near future and be reflected in a subsequent revision to the manual. A general discussion on some suggested infrastructure management procedures is provided below.

Alberta Transportation owns an increasing and sizable number of roadway lighting systems throughout the province of Alberta. The purpose of the infrastructure management program is to track each pole location and maintain an accurate record for a variety of purposes including:

- Overall value of infrastructure (age and maintenance procedures),
- Confirm actual number of luminaires and their wattages (monthly billing),
- Current condition of poles, bases, lights and wiring (ongoing maintenance),
- Identify ownership (TRANS or other)
- Identify warranty issues (construction follow up)

Procedure

The database will be kept up to date using the following methods:

- Each pole location requires a periodic inspection at least once every 7 years. Some pole locations may be subject to extreme road salt exposure (corrosion) or to damage by vandalism or vehicle collision.

- On new construction, each new location will be entered from the record drawings and warranty binder information.
- Each location will reference scheduled preventative maintenance or reactive emergency maintenance and the completed changes.

Records

The infrastructure management program will produce a database of information to provide Alberta Transportation with information on:

- Pole location (GPS and/or survey data from construction record drawings, install date if available, last maintenance procedure if available.)
- Base (Type, condition, picture)
- Pole (TRANS number, type, finish, BCD, existence of B/W base, condition, height, picture, other manufacturer data if available)
- Luminaire (Wattage, type, other manufacturer data if available)
- Wiring (fuse in handhole, cable type and size, circuit number, breaker size, wiring diagram)

Linkage to Maintenance

The database will also initiate preventative maintenance procedures which will tie into a maintenance contractor and scheduled work orders.