SALT LAKE CITY, UT
Street Lighting Master Plan

VOLUME 2 - TECHNICAL GUIDANCE AND IMPLEMENTATION

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LIGHTING DESIGN AND ENGINEERING

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LIGHTING DESIGN PROCESS

HOW TO USE THIS DESIGN GUIDE

This section outlines the street lighting design process and the steps to developing quality street and pedestrian lighting. The criteria used is from the Illuminating Engineering Society of North America's (IES) American National Standard Practice for Roadway Lighting (RP-8-18).

Lighting designers should evaluate each lighting installation on a block by block basis and use the criteria to identify the appropriate lighting strategy based on the information provided in the following sections.

LUMINAIRE SUBMITTAL FORMS

Designers and engineers will use street and pedestrian luminaire submittal forms found in Appendix E to ensure that all luminaire criteria, set forth in this chapter as well as in the Luminaire Criteria Tables, are met. These forms should be completed during the lighting design process and most of the information on the forms can be found in the luminaire specification sheet. These forms will aid the City in approving luminaire selection for construction.

PROCESS FOR EVALUATING THE LIGHTED ENVIRONMENT

DETERMINE LIGHTING STRATEGY BASED ON SITE LOCATION

The majority of lighting installations in Salt Lake City are street and/or pedestrian lights for which the City has adopted a standard. Using the same equipment for most installations reduces inventory and makes replacements and repairs more efficient and cost effective. However, this masterplan and existing lighting programs allow for areas within the city to differentiate themselves with unique lighting features. When designing street and pedestrian lighting, the designer must be aware of the area and if there are any unique influences. All new lighting in a character area should match and comply with luminaire style and criteria established in this Master Plan. Some character districts in the City, such as residential areas, may require lighting redesign, regardless of existing conditions to meet applicable criteria. Areas not included in a character district will be lighted with cobrahead style luminaires and standard pedestrian scale luminaires that meet the criteria and spacing based on road classification established in the Master Plan.

ESTABLISH LIGHTING WARRANTS

The Lighting Warrants Table below considers all factors and leads the designer to the appropriate lighting strategy based on street classification, adjacent land use, and pedestrian conflict. The next sections provide the user with background and guidance on the Lighting Warrants Chart to identify appropriate attributes and select the appropriate lighting strategy. The designer must use the appropriate strategy and include any character influences in their design. Not all streets in the City will warrant continuous lighting, but all streets with continuous lighting must meet the lighting criteria set forth by IES RP-8-18.

TABLE 1: LIGHTING WARRANTS - ARTERIAL

ARTERIAL STREET						
	PED	EXISTING CONDITIONS	STREET LIGHTING		PED LIGHTING	PG. #
COMMERCIAL	HIGH	Sidewalk Lit By Streetlight	Continuous	Optional	Non-cont.	25, 31
		Sidewalk NOT Lit by Streetlight	Continuous	&	Continuous	29
	MED	Sidewalk Lit By Streetlight	Continuous	Optional	Non-cont.	25
		Sidewalk NOT Lit by Streetlight	Continuous	&	Non-cont.	31
	LOW	Sidewalk Lit By Streetlight	Non-Cont.		NA	27
		Sidewalk NOT Lit by Streetlight	Non-cont.		NA	27
OFFICE PARK	LOW	Sidewalk Lit By Streetlight	Non-Cont.		NA	27
		Sidewalk NOT Lit by Streetlight	Non-cont.		NA	27
DOWNTOWN	HIGH	Cactus Poles	Continuous Cactus Pole Lighting			19
		Sidewalk Lit By Streetlight	Continuous	Optional	Non-cont.	25, 31
		Sidewalk NOT Lit by Streetlight	Continuous	&	Continuous	29
	MED	Cactus Poles	Continuous Cactus Pole Lighting			19
		Sidewalk Lit By Streetlight	Continuous	Optional	Non-cont.	25
		Sidewalk NOT Lit by Streetlight	Continuous	&	Non-cont.	31
INDUSTRIAL	LOW	Sidewalk Lit By Streetlight	Int. Only		NA	33
		Sidewalk NOT Lit by Streetlight	Int. Only		NA	33
MULTIFAMILY RESIDENTIAL	MED	Sidewalk Lit By Streetlight	Continuous	Optional	Non-cont.	25, 31
		Sidewalk NOT Lit by Streetlight	Continuous	&	Non-cont.	31
SINGLE FAMILY RESIDENTIAL	LOW	Sidewalk Lit By Streetlight	Continuous	Optional	Non-cont.	25, 31
		Sidewalk NOT Lit by Streetlight	Continuous	Optional	Non-cont.	25, 31
OPEN SPACE	MED	Sidewalk Lit By Streetlight	Non-Cont.		NA	27
		Sidewalk NOT Lit by Streetlight	Non-cont.		NA	27
	LOW	Sidewalk Lit By Streetlight	Int. Only		NA	33
		Sidewalk NOT Lit by Streetlight	Int. Only		NA	33

* High pedestrian conflict is only found in Downtown, Sugarhouse, Trolley Square, and within one block of the University of Utah and Smith's Ballpark

TABLE 2: LIGHTING WARRANTS - COLLECTOR

COLLECTOR						
	PED	EXISTING CONDITIONS	STREET LIGHTING		PED LIGHTING	PG. #
COMMERCIAL	HIGH	Sidewalk Lit By Streetlight	Continuous	OR	Continuous	34
		Sidewalk NOT Lit by Streetlight	Continuous	&	Continuous	38
	MED	Sidewalk Lit By Streetlight	Continuous	OR	Continuous	34
		Sidewalk NOT Lit by Streetlight	Continuous	&	Non-cont.	40
	LOW	Sidewalk Lit By Streetlight	Non-cont.		NA	36
		Sidewalk NOT Lit by Streetlight	Non-Cont.		NA	36
OFFICE PARK	LOW	Sidewalk Lit By Streetlight	Non-cont.		NA	36
		Sidewalk NOT Lit by Streetlight	Non-cont.		NA	36
DOWNTOWN	HIGH	Cactus Poles	Continuous Cactus Pole Lighting			19
		Sidewalk Lit By Streetlight	Continuous	OR	Continuous	34
		Sidewalk NOT Lit by Streetlight	Continuous	&	Continuous	38
	MED	Cactus Poles	Continuous Cactus Pole Lighting			19
		Sidewalk Lit By Streetlight	Continuous	OR	Continuous	34
		Sidewalk NOT Lit by Streetlight	Continuous	&	Non-Cont.	40
INDUSTRIAL	LOW	Sidewalk Lit By Streetlight	Int. Only		NA	44
		Sidewalk NOT Lit by Streetlight	Int. Only		NA	44
MULTIFAMILY RESIDENTIAL	MED	Sidewalk Lit By Streetlight	Continuous	Optional	Non-cont.	42
		Sidewalk NOT Lit by Streetlight	Continuous	&	Non-cont.	40
SINGLE FAMILY RESIDENTIAL	LOW	Sidewalk Lit By Streetlight	Non-Cont.	OR	Non-cont.	36,42
		Sidewalk NOT Lit by Streetlight	Int. Only	&	Non-cont.	44,42
OPEN SPACE	MED	N/A				
	LOW	Sidewalk Lit By Streetlight	Int. Only		NA	44
		Sidewalk NOT Lit by Streetlight	Int. Only		NA	44

* High pedestrian conflict is only found in Downtown, Sugarhouse, Trolley Square, and within one block of the University of Utah and Smith's Ballpark

TABLE 3: LIGHTING WARRANTS - LOCAL

LOCAL						
	PED	EXISTING CONDITIONS	STREET LIGHTING		PED LIGHTING	PG. #
COMMERCIAL	HIGH	Sidewalk Lit By Streetlight	Continuous	OR	Continuous	45,50
		Sidewalk NOT Lit by Streetlight	Non-cont.	&	Continuous	48
	MED	Sidewalk Lit By Streetlight	Non-Cont.	OR	Continuous	47, 50
		Sidewalk NOT Lit by Streetlight	Non-cont.	OR	Continuous	47, 50
	LOW	Sidewalk Lit By Streetlight	Int. Only	OR	Non-cont.	36
		Sidewalk NOT Lit by Streetlight	Int. Only	OR	Non-cont.	36
OFFICE PARK	LOW	Sidewalk Lit By Streetlight	Int. Only	OR	Non-cont.	53, 52
		Sidewalk NOT Lit by Streetlight	Int. Only	OR	Non-cont.	53, 52
DOWNTOWN	HIGH	Cactus Poles	Continuous Cactus Pole Lighting			19
		Sidewalk Lit By Streetlight	Continuous	OR	Continuous	45,50
		Sidewalk NOT Lit by Streetlight	Non-cont.	&	Continuous	48
	MED	Cactus Poles	Continuous Cactus Pole Lighting			19
		Sidewalk Lit By Streetlight	Non-Cont.	OR	Continuous	47, 50
		Sidewalk NOT Lit by Streetlight	Non-Cont.	OR	Continuous	47, 50
INDUSTRIAL	LOW	Sidewalk Lit By Streetlight	Int. Only		NA	53
		Sidewalk NOT Lit by Streetlight	Int. Only		NA	53
MULTIFAMILY RESIDENTIAL	MED	Sidewalk Lit By Streetlight	Int. Only	&	Continuous	53
		Sidewalk NOT Lit by Streetlight	Int. Only	&	Continuous	53
SINGLE FAMILY RESIDENTIAL	LOW	Sidewalk Lit By Streetlight	Int. Only	Optional	Non-Cont.	53, 52
		Sidewalk NOT Lit by Streetlight	Int. Only	Optional	Non-cont.	53, 52
OPEN SPACE	MED	N/A				
	LOW	Sidewalk Lit By Streetlight	Int. Only		NA	53
		Sidewalk NOT Lit by Streetlight	Int. Only		NA	53

* High pedestrian conflict is only found in Downtown, Sugarhouse, Trolley Square, and within one block of the University of Utah and Smith's Ballpark

DETERMINE STREET CLASSIFICATIONS

Street classification is used to determine the lighting warrants for a street, along with the surrounding environment and pedestrian conflict. Figure 1 shows all street classifications throughout the city. The following street and roadway definitions are from IES RP-8-18.

FREEWAY:

A divided highway with full control of access. Oftentimes with great visual complexity and high traffic volumes. This roadway is usually found in major metropolitan areas in or near the central core and will operate at or near design capacity through some of the early morning or late evening hours of darkness.

*Freeway, which are UDOT facilities, are not included in the scope of this Masterplan.

MAJOR (ARTERIAL):

That part of the roadway system that serves as the principle network for through-traffic flow. The routes connect areas of principle traffic generation and important rural roadways entering and leaving the city. These routes are often known as “arterials”. They are sometimes subdivided into primary and secondary; however, such distinctions are not necessary in roadway lighting. These routes primarily serve through traffic and secondarily provide access to abutting property.

COLLECTOR:

Roadways servicing traffic between major and local streets. These are streets used mainly for traffic movements within residential, commercial, and industrial areas. They do not handle long, through trips. Collector streets may be used for truck or bus movements and give direct service for abutting properties.

LOCAL:

Local streets are used primarily for direct access to residential, commercial, industrial, or other abutting property. They make up a sizable percentage of the total street system but carry a small proportion of vehicular traffic.

INTERSECTIONS:

A traffic conflict area in which two or more streets join or cross at the same grade. The outside edge of pedestrian crosswalks defines intersection limits. If there are no pedestrian crosswalks, the stop bars define the intersection. If there are no stop bars, the intersection is defined by the radius return of each intersection leg. Intersection limits may also include the area encompassing channelized areas in which traffic is directed into definite paths by islands with raised curbing.

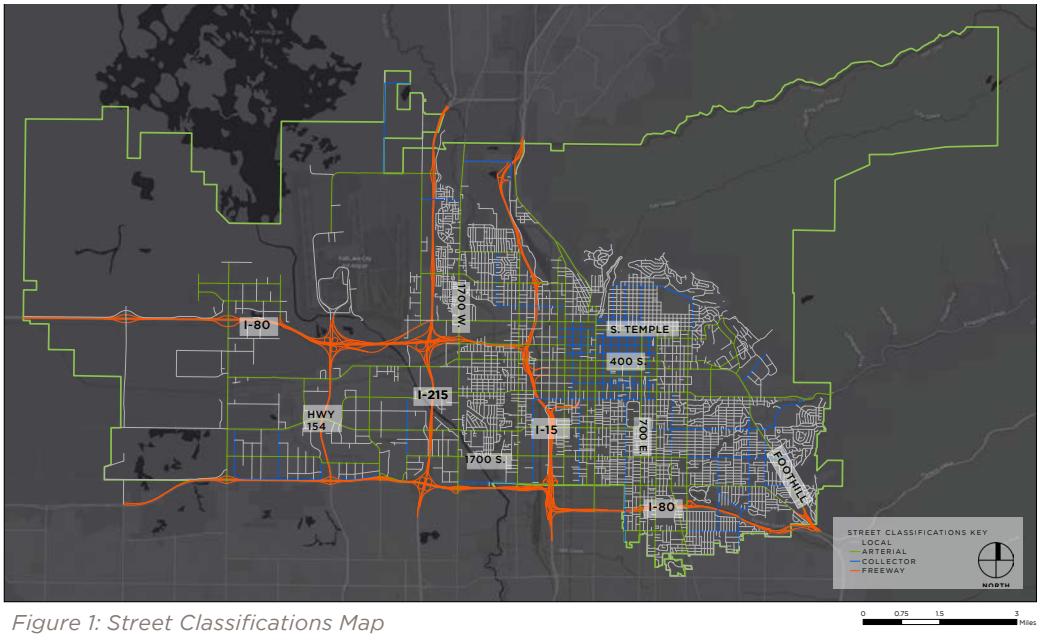

Figure 1: Street Classifications Map

DETERMINE ADJACENT LAND USE

Adjacent land use is a key factor in determining lighting strategy as it directly correlates to the number of pedestrians and vehicles in the area during nighttime hours. Areas of increased traffic volume at night warrant additional lighting, whereas areas that typically do not have much traffic after dark warrant base level lighting. Figure 2 is the Land Use Map. Adjacent land use should be evaluated according to the consolidated zoning provided in this master plan. For projects that are on the boundaries between land uses, the designer should select the lower criteria with more stringent light trespass to protect residential and open space uses. If the project includes areas that are within, or adjacent to, a Critical Wildlife Area, all luminaire installed should meet the luminaire requirements of the protected area.

COMMERCIAL

Commercial land use is a diverse classification encompassing high, medium and low pedestrian and traffic volumes. Areas with concentrated restaurant and retail establishments, such as the Sugarhouse Business District and 9th & 9th, typically see medium to high pedestrian and traffic volumes during nighttime hours and should have increased light levels and possibly additional pedestrian lighting. However, big box stores and strip malls do not typically see the same number of pedestrians during nighttime hours and can have reduced light levels. Designers must carefully evaluate the pedestrian and traffic volume where lighting improvements are being made and select the proper lighting criteria to create a safe and comfortable nighttime environment for pedestrians and vehicles.

OFFICE PARK

Office Parks are defined as areas where people tend to work during the day but are mostly vacant during nighttime hours. Establishments in this classification are generally open between 8:00 A.M. and 6:00 P.M. but typically close in the early evening and are not open into the night.

DOWNTOWN

Downtown Salt Lake City is the heart of the retail and restaurant business in the valley and attracts people at all times of the day. This area typically sees high and medium pedestrian and traffic volumes and is lighted by the historic Cactus Poles. Lighting in Downtown should focus on pedestrian safety and properly illuminating crosswalks and sidewalks. In most cases luminaire spacing has already been established so it is essential that designers select the proper distribution and lumen output

INDUSTRIAL

Industrial land use is defined by manufacturing and distribution within the City. This land use includes, but is not limited to, the establishments found south of the airport off of California Ave. Industrial land use has very minimal pedestrian usage, especially during nighttime hours and requires minimal lighting. Additionally, most of the industrial land use areas within Salt Lake City are also within Critical Wildlife Habitats and will require appropriate lighting to minimize environmental impacts.

MULTIFAMILY RESIDENTIAL

Multifamily residential is characterized by multiple separate housing units for residential inhabitants are contained within on building or several buildings within one complex. When designing lighting on streets adjacent to multifamily residential areas a medium pedestrian conflict should be used as there are typically higher pedestrian and vehicle volumes. Residential areas are typically on streets with lower speed limits and less traffic, however this is not always the case. Salt Lake City has residential land use on all street classifications, arterial, collector and local creating multiple lighting strategies that may be appropriate. Designers should consider the safety of pedestrian and vehicles when selecting the appropriate lighting strategy while respecting the residents by minimizing light trespass.

SINGLE FAMILY RESIDENTIAL

Single family residential is characterized by a stand-alone dwelling serving as the primary residence for one family. Single family residential areas typically have less pedestrian volume and when designing lighting in these areas, a low pedestrian conflict should be used. Residential areas are typically on streets with lower speed limits and less traffic, however this is not always the case. Salt Lake City has residential land use on all street classifications, arterial, collector and local creating multiple lighting strategies that may be appropriate. Designers should consider the safety of pedestrian and vehicles when selecting the appropriate lighting strategy while respecting the residents by minimizing light trespass.

OPEN SPACE

The purpose of the OS Open Space District is to preserve and enhance public and private open space, natural areas, and improved park and recreational areas. These areas serve to provide opportunities for active and passive outdoor recreation, provide contrasts to the built environment, preserve scenic qualities, and protect sensitive or fragile environmental areas. Examples of Open Space within the City include City Creek Canyon, Salt Lake City Cemetery, and along the Jordan River. Any Streets bordering the foothills are considered to be along Open Space as well. These streets typically see minimal pedestrian usage and are within Critical Habitat areas requiring additional measures to ensure environmentally friendly street lights are used.

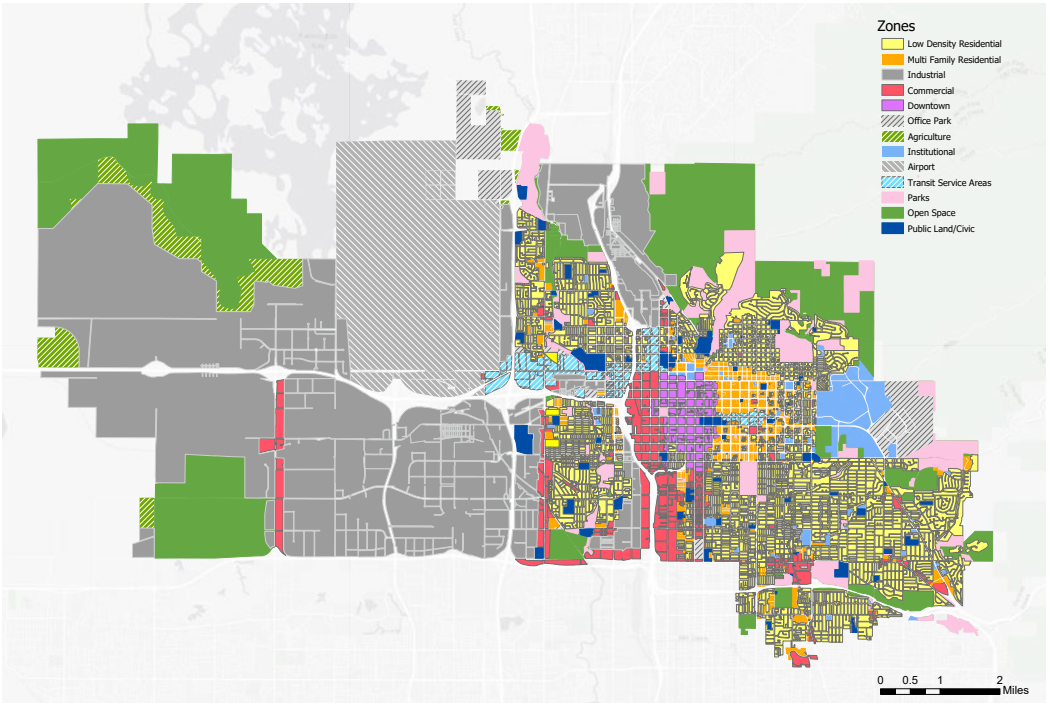

Figure 2: Adjacent Land Use Map

DETERMINING PEDESTRIAN ACTIVITY LEVELS

IES pedestrian volumes represent the total number of pedestrians walking in both directions on a typical block or 660 foot section. Pedestrian counts and traffic studies take precedence over other references. The following are pedestrian classification definitions per IES RP-8-18. The pedestrian counts should be taken during darkness hours when the typical peak number of pedestrians are present. This typically occurs during early morning hours if a school or similar destinations are nearby. The lighting designer should determine what the typical peak hours are for each street.

HIGH:

Areas with significant numbers (over 100 pedestrians an hour) of pedestrians expected to be on the sidewalks or crossing the streets during darkness. Examples are downtown retail areas, near theaters, concert halls, stadiums, and transit terminals.

MEDIUM:

Areas where fewer (10 to 100 pedestrians an hour) pedestrians utilize the streets at night. Typical are downtown office areas, blocks with libraries, apartments, neighborhood shopping, industrial, parks, and streets with transit lines.

LOW:

Areas with very low volumes (10 or fewer pedestrians per hour) of night pedestrian usage. A low pedestrian classification can occur in any street classifications but may be typified by suburban streets with single family dwellings, very low-density residential developments, and rural or semi-rural areas.

COMPREHENSIVE IMPROVEMENTS

PURPOSE

This section applies to new installations of public street and pedestrian lighting, either stand alone or on traffic signal installations, and modifications to existing street lighting installations that affect pole types or locations, excluding minor maintenance work. Refer to Volume 2: Minimal Improvements for projects involving 1-for-1 luminaire replacement and supplemental improvements.

LIGHTING DESIGN PROCESS

Performing a lighting design for new installations of streetlights is an iterative process. This occurs because the lighting design is altered (spacing, arrangement, mounting height) until the target goal is met, per criteria set forth in this document, for the specific street. The most efficient method is to calculate luminance for straight streets or illuminance for intersections and non-straight streets, along with sidewalks and other pedestrian areas with varying luminaire parameters. The selected luminaire must comply with the lumen output, efficacy, BUG ratings, and other luminaire requirements specified in Volume 2. Care should be taken, when selecting a luminaire to illuminate the surrounding sidewalks and public spaces without causing light trespass, or unwanted light spills onto surrounding properties and through residential windows. Instructions on setting up the lighting design calculations are found later in this volume.

Lighting designers should use the Lighting Warrants Table to determine the appropriate strategy based on street classification, adjacent land use, and pedestrian conflict. Once the appropriate lighting strategy is determined, designers can find lighting and luminaire criteria and spacing guidance in the corresponding sheets below. All lighting layouts for each street classification are broken out below and should be referenced during the design process.

LIGHTING APPLICATIONS

The following pages describe the luminaire selection and lighting layout for each street classification as defined by the Salt Lake City Transportation Division. Designers should strive to meet the luminaire spacing that will provide the highest quality street lighting possible, but this is not always feasible. It is necessary to integrate lighting locations in correspondence to other improvements:

- Clearance from driveways (10 feet commercial and 5 feet residential).
- Clearance from fire hydrants (5 feet).
- Trees (centered in between trees or 20 feet from the tree trunk).
- Streetlight offset should be a minimum of 3’-0” and a maximum of 8’-0” from back of curb.
- Pedestrian lights should be a minimum of 1’-0” and a maximum of 6’-0” from sidewalk.
- Light standards integrated into sidewalk should maintain a minimum of 5’-0” clear zone.
- Light standards should be located a minimum distance of 10’-0” from trees.

Place poles and luminaires near property lines wherever practical and avoid locations in front of doorways, windows, and lines of egress.

INTERSECTIONS & CROSSWALKS

The same luminaires are to be used throughout the intersection. When an intersection is between two different street classifications, the higher street classification target criteria is used throughout the entire intersection. The recommended streetlight layout for an intersection is also dependent on whether the street classification calls for continuous or non-continuous lighting.

The following requirements are recommended to guide all traffic signal mounted streetlights. The intersection design should ensure that the crosswalks are sufficiently lighted to light the vertical surface (body) of pedestrians in the crosswalk. This may require that additional streetlights be located before the intersection as shown in the Figures 3 and 4 below.

Mid-block crossings and denoted crosswalks are recommended to always be lighted. Crosswalks can be denoted by striping, signage, flashing beacons, etc. Crosswalks are important parts of the streetscape and an appropriate lighting design will improve the visibility of pedestrians in the crosswalk. The lighting should be installed between the vehicle and the crosswalk (ie: half to one pole height before the crosswalk) to ensure that the body of the pedestrian is adequately lighted. If streetlights are installed above or immediately adjacent to the crosswalk, only the top of the pedestrian's head will be lighted making it difficult for motorists to see the pedestrian. Crosswalks and mid-block crossings are recommended to be lighted to the Vertical Illuminance requirements in the table below. Vertical illuminance measurements are taken 5ft. above the roadway surface in the direction of oncoming traffic.

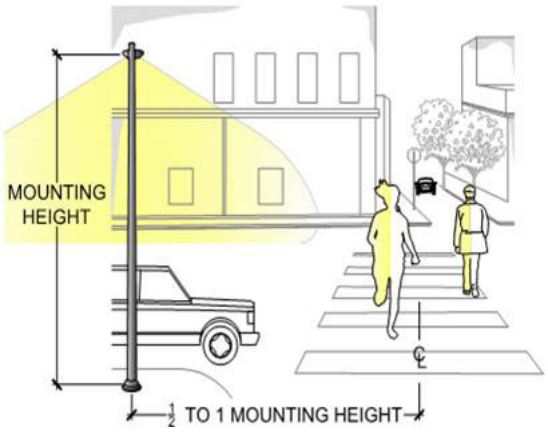

Figure 3: Streetlight Located Before Crosswalk

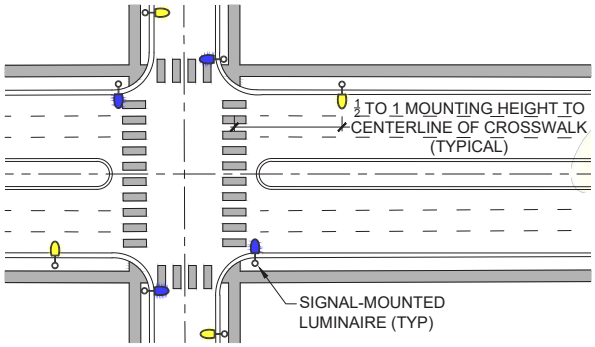

Figure 4: Streetlight Placement with Respect to Crosswalk

TABLE 4: INTERSECTION & CROSSWALK TARGET HORIZONTAL CRITERIA PER IES RP-8-18

STREET CLASS	PED CONFLICT	AVERAGE HORIZONTAL ILLUMINANCE (FC)	UNIFORMITY RATIO (FCAVG/ FCMIN)	AVERAGE VERTICAL ILLUMINANCE (FC)	MOUNTING HEIGHT (FEET)	MAST ARM LENGTH (FT)	DISTRIBUTION	MAX BUG RATING	LUMEN OUTPUT RANGE
Arterial / Arterial	High	3.4	3	1.4	35-40	10	Type 2 or 3	3-0-3	16,000-25,000
	Medium	2.6	3	0.9	35-40	10	Type 2 or 3	3-0-3	10,000-16,000
	Low	1.8	3	0.5	30-40	10	Type 2 or 3	2-0-2	7,000-12,000
Arterial / Collector	High	2.9	3	0.9	35-40	10	Type 2 or 3	3-0-3	10,000-18,000
	Medium	2.2	3	0.6	35-40	10	Type 2 or 3	2-0-2	8,500-13,500
	Low	1.5	3	0.4	30-40	10	Type 2 or 3	2-0-2	5,000-10,000
Arterial / Local	High	2.6	3	0.8	30-35	10	Type 2 or 3	3-0-3	10,000-16,000
	Medium	2.0	3	0.6	30-35	10	Type 2 or 3	2-0-2	7,500-12,500
	Low	1.3	3	0.4	30-35	10	Type 2 or 3	2-0-2	4,000-8,500
Collector / Collec-tor	High	2.4	4	0.7	30-35	6	Type 2 or 3	2-0-2	7,500-12,000
	Medium	1.8	4	0.5	30-35	6	Type 2 or 3	2-0-2	4,500-7,500
	Low	1.2	4	0.5	30-35	6	Type 2 or 3	1-0-2	3,500-6,000
Collector / Local	High	2.1	4	0.6	30-35	6	Type 2 or 3	2-0-2	6,000-10,500
	Medium	1.6	4	0.5	30-35	6	Type 2 or 3	1-0-2	4,000-7,000
	Low	1.0	4	0.3	30-35	6	Type 2 or 3	1-0-2	3,000-5,500
Local / Local >30mph	High	1.8	6	0.5	25-30	6	Type 2 or 3	2-0-2	5,000-8,000
	Medium	1.4	6	0.4	25-30	6	Type 2 or 3	1-0-1	4,000-6,000
	Low	1.0	6	0.2	25-30	6	Type 2 or 3	1-0-1	3,000-5,500
Local / Local <30mph	High	N/A							
	Medium	N/A							
	Low	N/A							

* A U2 BUG rating is acceptable when using a house side shield?
1. Arterial mid block crossing shall follow the arterial/arterial intersection criteria.
2. Collector mid block crossing shall follow the collector/collector intersection criteria.

SIGNALIZED/CONTINUOUS LIGHTING

For a signalized intersection with continuous lighting the typical streetlight arrangement is interrupted by placing streetlight signal poles. This is called out as "1/2 to 1 mounting height to centerline of crosswalk (Typical)" in Figure 5 below. Additional streetlights should be located on signal poles if additional lighting is needed to meet the intersection criteria.

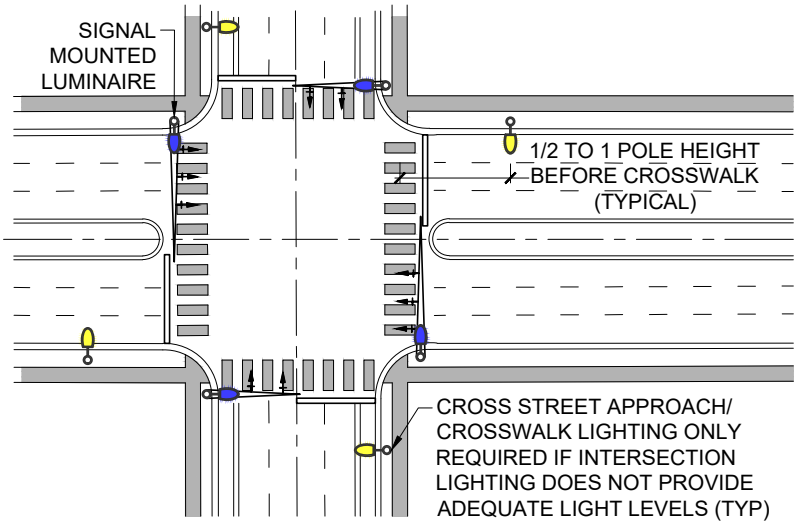

Figure 5: Typical Intersection Lighting Layout with Signals and Continuous Lighting

NON- SIGNALIZED/CONTINUOUS LIGHTING

For a non-signalized intersection with continuous lighting the typical streetlight arrangement is continued through the intersection (see Figure 6). The streetlights should be located along the approach to the crosswalk, if it exists, installed half to one luminaire mounting height in front of the crosswalk, between approaching vehicles and pedestrians.

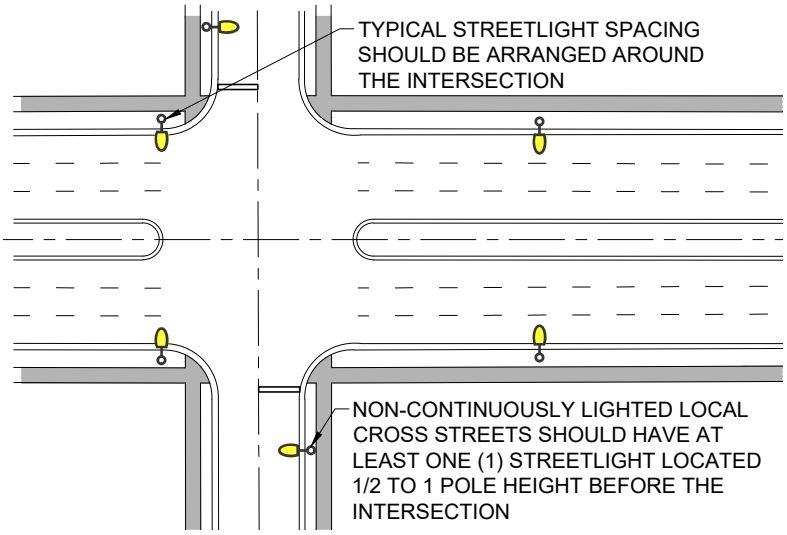

Figure 6: Typical Intersection Lighting Layout with No Signals and Continuous Lighting

SIGNALIZED/NON-CONTINUOUS LIGHTING

For signalized intersections with non-continuous lighting luminaires are located half to one luminaire mounting height in front of the crosswalk, illuminating the approach to the intersection. If these four luminaires do not provide sufficient lighting throughout the entire intersection, two more additional luminaires may be used, to be mounted on the signals as shown in Figure 7.

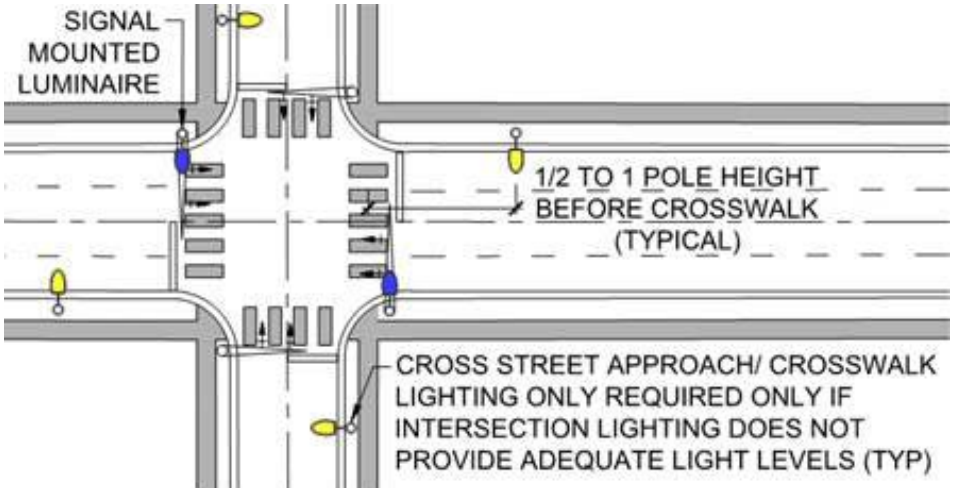

Figure 7: Typical Intersection Lighting Layout with Signals and Non-Continuous Lighting

NON-SIGNALIZED/NON-CONTINUOUS LIGHTING

For streets with non-continuous lighting and no signals, one luminaire is to be placed at each intersection, as shown in Figure 8. Refer to the Local Street chapter for more information.

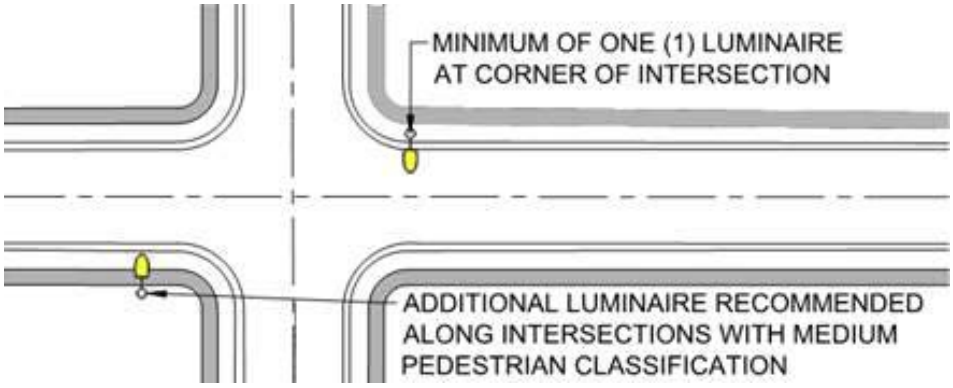

Figure 8: Typical Intersection Lighting Layout with No Signals and Non-Continuous Lighting

MID-BLOCK CROSSWALKS

The standard is a streetlight located one half to 1 mounting height in front of the crosswalk on both sides of the street for all mid-block crossings, shown in Figures 9 and 10.

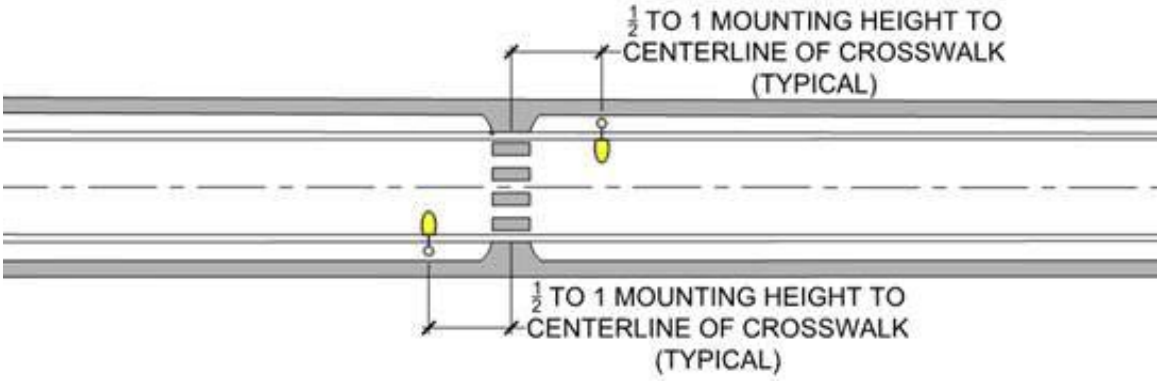

Figure 9: Streetlight Placement with Respect to Mid-Block Crossing

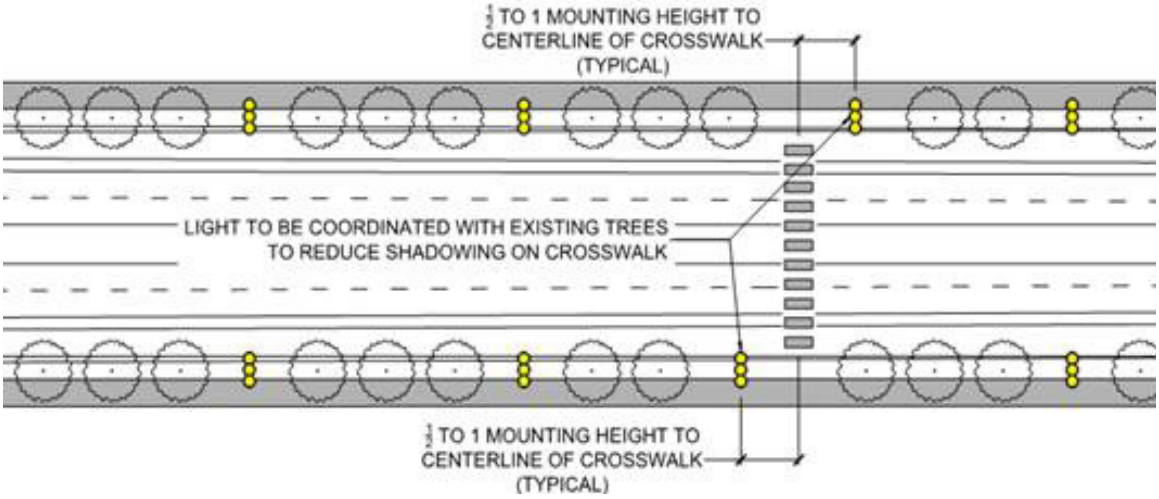

Figure 10: Cactus Pole Placement with Respect to Mid-Block Crossing

CACTUS POLE LAYOUTS

Cactus Poles within downtown SLC should be upgraded to fully shielded LED luminaires. The Cactus Pole locations and spacing will not change, but the lumen output and distribution of new luminaire should meet the criteria in Table 7 and 8 based on the location of the lighting improvements seen in Figure 11 and 12.

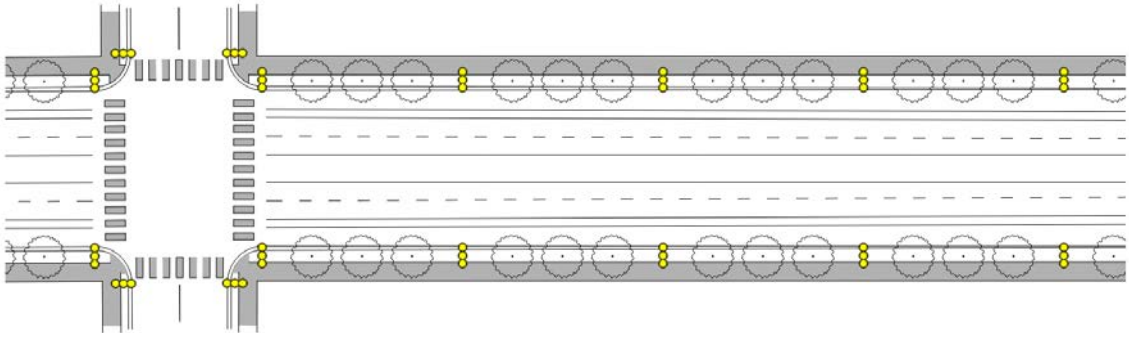

Figure 11: Cactus Pole Lighting Layouts

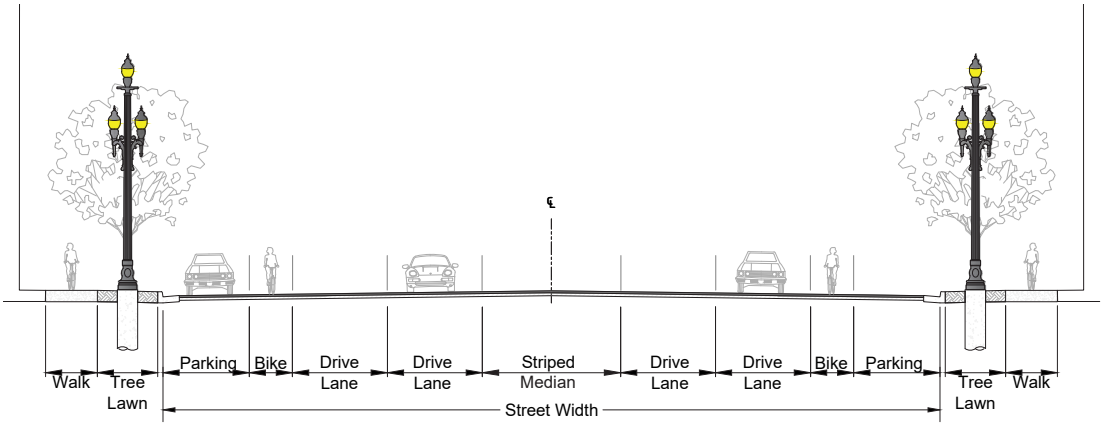

Figure 12: Cactus Pole Sections

TABLE 5: ARTERIAL STREET TARGET CRITERIA PER IES RP-8-18

PEDESTRIAN ACTIVITY	ROADWAY		SIDEWALKS
	AVERAGE LUMINANCE (CD/M2)	LUMINANCE AVG:MIN RATIO	AVERAGE ILLUMINANCE (FC)
High	1.2	3:1	1.0
Medium	0.9	3:1	0.5

TABLE 6: COLLECTOR STREET TARGET CRITERIA PER IES RP-8-18

PEDESTRIAN ACTIVITY	ROADWAY		SIDEWALKS
	AVERAGE LUMINANCE (CD/M2)	LUMINANCE AVG:MIN RATIO	AVERAGE ILLUMINANCE (FC)
High	0.8	3:1	1.0
Medium	0.6	4:1	0.5

TABLE 7: RECOMMENDED CACTUS POLE LUMINAIRE CRITERIA - ARTERIAL STREETS

STREET WIDTH	PEDESTRIAN ACTIVITY	STREET LIGHT LUMEN OUTPUT (LM)	STREET LIGHT PHOTOMETRIC DISTRIBUTION	MAX. STREET LIGHT BUG RATING	PEDESTRIAN LIGHT LUMEN OUTPUT (LM)	PEDESTRIAN LIGHT PHOTOMETRIC DISTRIBUTION	MAX. PEDESTRIAN LIGHT BUG RATING
70-90	High	8,500-10,500	Type III or IV	B3-U0-G2*	3,000-5,000	Type III or IV	B1-U0-G1
	Medium	5,500-9,000	Type III	B3-U0-G2*	3,000-5,000	Type III	B1-U0-G1
90-110	High	6,500-9,500	Type II	B3-U0-G2*	3,500-5,500	Type III	B1-U0-G1
	Medium	8,000-11,500	Type III	B3-U0-G2*	2,500-5,000	Type II or III	B1-U0-G1

** These BUG Ratings apply to all Cactus Pole lights, except at intersections and mid-block pedestrian crossings, which may have B3-U3-G2 Ratings to provide adequate vertical illuminance at crosswalks."*

TABLE 8: RECOMMENDED CACTUS POLE LUMINAIRE CRITERIA - COLLECTOR STREETS

STREET WIDTH	PEDESTRIAN ACTIVITY	STREET LIGHT LUMEN OUTPUT (LM)	STREET LIGHT PHOTOMETRIC DISTRIBUTION	MAX. STREET LIGHT BUG RATING	PEDESTRIAN LIGHT LUMEN OUTPUT (LM)	PEDESTRIAN LIGHT PHOTOMETRIC DISTRIBUTION	MAX. PEDESTRIAN LIGHT BUG RATING
70-90	High	5,500-8,500	Type III or IV	B2-U0-G2	2,500-4,500	Type III or IV	B1-U0-G1
	Medium	4,500-8,000	Type II or IV	B2-U0-G2	2,500-4,500	Type III or IV	B1-U0-G1
90-110	High	9,000-11,500	Type III	B3-U0-G2	3,000-5,000	Type III or IV	B1-U0-G1
	Medium	4,500-7,500	Type III or IV	B2-U0-G2	3,000-5,000	Type III or IV	B1-U0-G1

SUGARHOUSE POLE LAYOUT

The teardrop luminaires in the Sugarhouse Business District should be upgraded to fully shielded LED luminaires. The locations and spacing will not change, but the lumen output and distribution of new luminaire should meet the criteria in Table 10. This is illustrated in Figures 13 and 14.

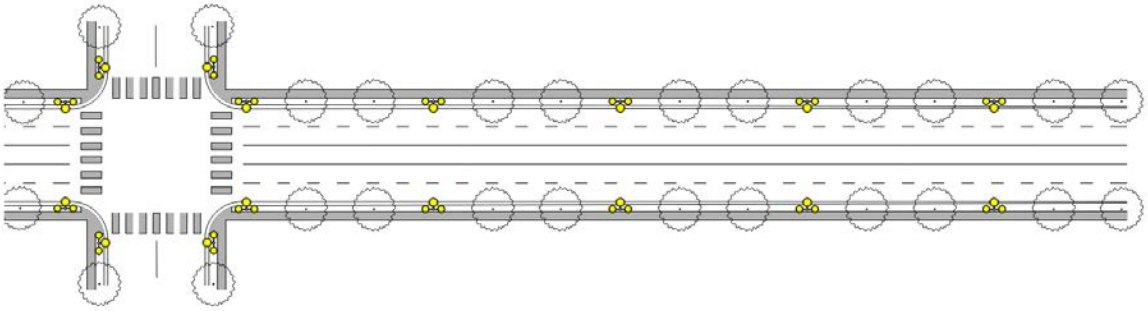

Figure 13: Sugarhouse Pole Lighting Layouts

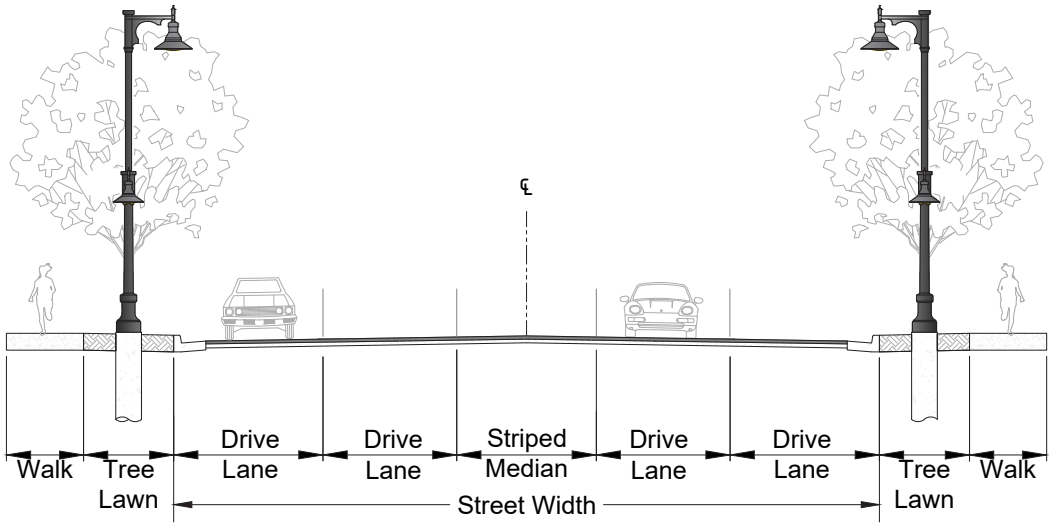

Figure 14: Sugarhouse Pole Lighting Section

TABLE 9: ARTERIAL STREET TARGET CRITERIA PER IES RP-8-18

PEDESTRIAN ACTIVITY	ROADWAY		SIDEWALKS
	AVERAGE LUMINANCE (CD/M2)	LUMINANCE AVG:MIN RATIO	AVERAGE ILLUMINANCE (FC)
High	1.2	3:1	1.0
Medium	0.9	3:1	0.5

TABLE 10: RECOMMENDED SUGARHOUSE POLE LUMINAIRE CRITERIA

PEDESTRIAN ACTIVITY	STREET LIGHT LUMEN OUTPUT (LM)	STREET LIGHT PHOTOMETRIC DISTRIBUTION	MAX. STREET LIGHT BUG RATING	PEDESTRIAN LIGHT LUMEN OUTPUT (LM)	PEDESTRIAN LIGHT PHOTOMETRIC DISTRIBUTION	MAX. PEDESTRIAN LIGHT BUG RATING
High	6,000-8,000	Type II or III	B2-U0-G2	2,000-3,000	Type II or III	B1-U0-G1
Medium	3,000-7,000	Type II or III	B2-U0-G1	1,000-2,000	Type II or III	B1-U0-G1

TEAR DROP POLE LAYOUT

The teardrop luminaires along South Temple and State Street should be upgraded to fully shielded LED luminaires. The locations and spacing will not change, but the lumen output and distribution of new luminaire should meet the criteria in Table 12. This is illustrated in Figures 15 and 16.

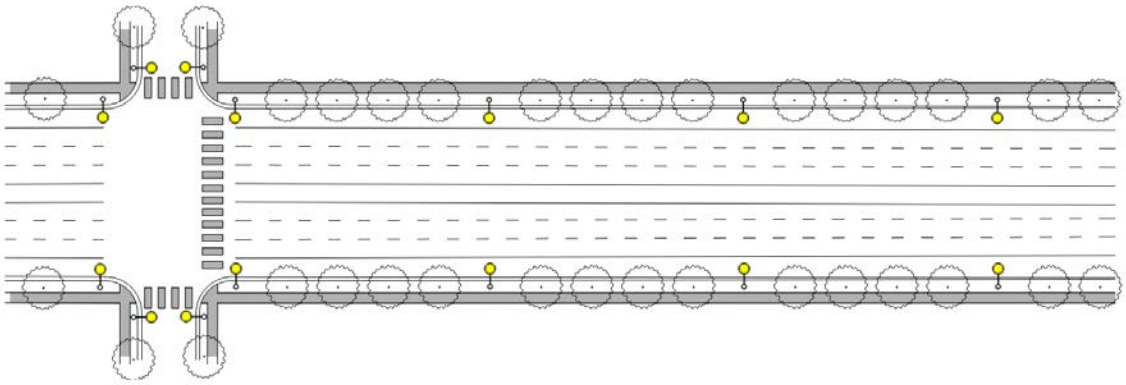

Figure 15: Tear Drop Lighting Layouts

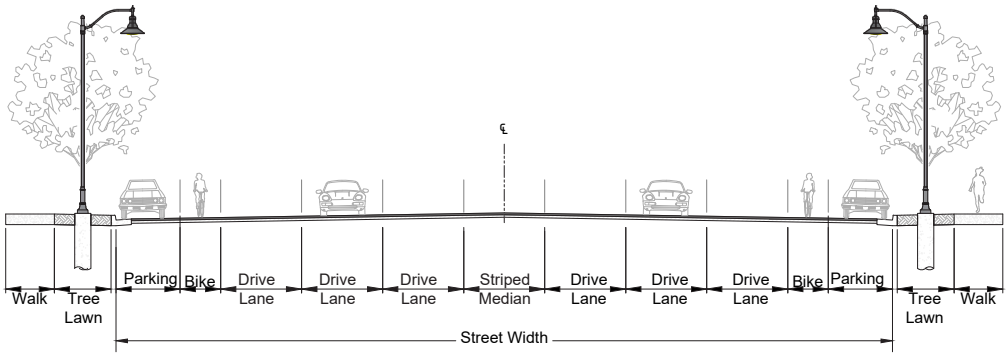

Figure 16: Tear Drop Lighting Section

TABLE 11: ARTERIAL STREET TARGET CRITERIA PER IES RP-8-18

PEDESTRIAN ACTIVITY	ROADWAY		SIDEWALKS
	AVERAGE LUMINANCE (CD/M2)	LUMINANCE AVG:MIN RATIO	AVERAGE ILLUMINANCE (FC)
High	1.2	3:1	1.0
Medium	0.9	3:1	0.5
Low	0.6	4:1	0.4

TABLE 12: RECOMMENDED TEAR DROP LUMINAIRE CRITERIA

STREET WIDTH	PEDESTRIAN ACTIVITY	LUMEN OUTPUT (LM)	TYPICAL PHOTOMETRIC DISTRIBUTION	MAX. BUG RATING
50-70	High	11,000-14,750	Type III	B2-U0-G2
	Medium	8,500-12,000	Type III	B2-U0-G2
	Low	5,500-8,500	Type III	B2-U0-G2
70-100	High	16,500-20,500	Type III	B3-U0-G3
	Medium	16,500-20,500	Type III	B3-U0-G3
	Low	11,000-16,500	Type III	B2-U0-G2

ARTERIAL STREET – CONTINUOUS STREET LIGHTING

The figures and tables below provide direction on the appropriate luminaire selection and non-median lighting layout when designing an arterial street with only street lighting. Luminaires are to be placed in an opposite arrangement when not located at an intersection, Figures 17 and 18.

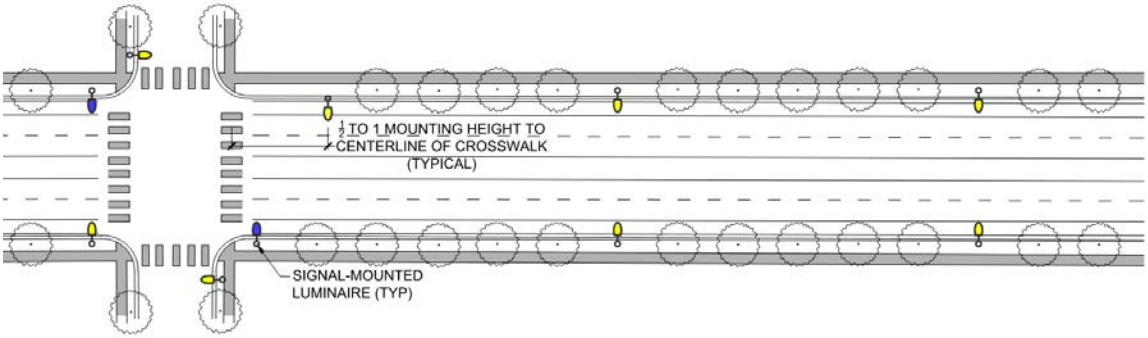

Figure 17: Typical Arterial with Continuous Street Lighting Plan

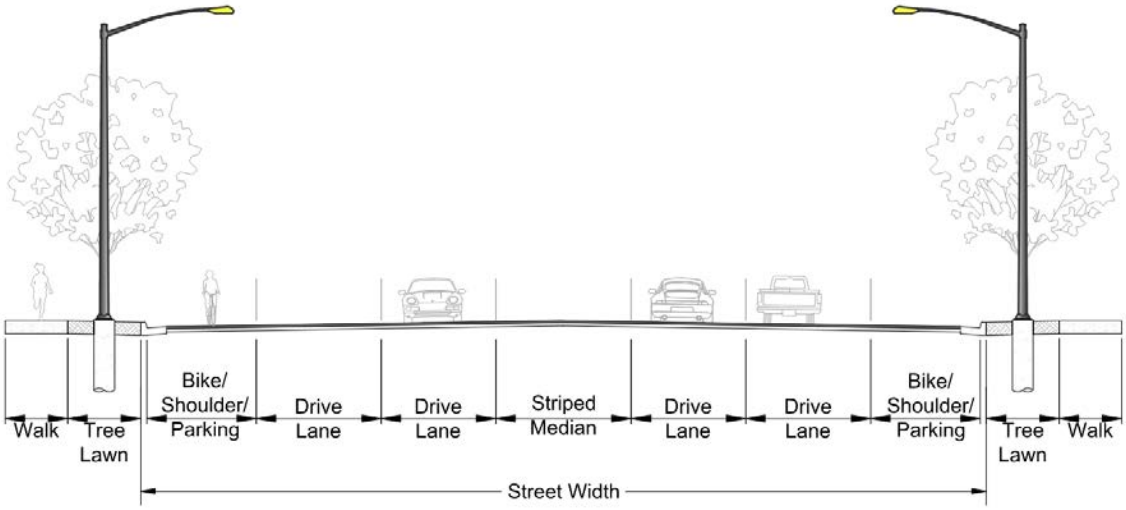

Figure 18: Typical Arterial with Continuous Street Lighting Cross Section

TABLE 13: ARTERIAL STREET TARGET CRITERIA PER IES RP-8-18

PEDESTRIAN ACTIVITY	ROADWAY		SIDEWALKS
	AVERAGE LUMINANCE (CD/M2)	LUMINANCE AVG:MIN RATIO	AVERAGE ILLUMINANCE (FC)
High	1.2	3:1	1.0
Medium	0.9	3:1	0.5
Low	0.6	4:1	0.4

TABLE 14: RECOMMENDED ARTERIAL (NON-MEDIAN MOUNTED) LUMINAIRE & POLE CRITERIA

STREET WIDTH (FT)	PEDESTRIAN ACTIVITY	POLE SPACING (FT)	POLE HEIGHT (FT)	LUMEN OUTPUT (LM)	TYPICAL PHOTOMETRIC DISTRIBUTION	MAX. BUG RATING
50-70	High	120-140	30-35	6,500-9,000	Type II or III	B2-U0-G2
		140-180	30-35	8,500-14,000	Type II or III	B3-U0-G2
	Medium	140-180	30-35	6,500-9,000	Type II or III	B2-U0-G2
		180-220	30-35	8,500-10,000	Type II or III	B2-U0-G2
	Low	180-220	30-35	6,000-8,500	Type II or III	B2-U0-G2
70-90	High	140-180	30-35	8,500-12,000	Type II or III	B2-U0-G2
		180-220	30-35	12,000-18,000	Type II or III	B3-U0-G3
	Medium	120-160	30-35	7,500-10,000	Type II or III	B2-U0-G2
		160-200	30-35	8,500-12,000	Type II or III	B3-U0-G2
	Low	140-180	30-35	6,500-9,500	Type II or III	B2-U0-G2
		180-220	30-35	7,500-11,000	Type II or III	B2-U0-G2
90-110	High	120-160	30-35	11,000-18,000	Type II	B3-U0-G3
	Medium	140-180	30-35	10,000-18,000	Type II or III	B2-U0-G2
		180-220	30-35	15,000-19,000	Type II or III	B3-U0-G3
	Low	140-180	30-35	8,000-13,000	Type II or III	B2-U0-G2
		180-220	30-35	12,000-14,500	Type II or III	B2-U0-G2

ARTERIAL STREET - NON-CONTINUOUS STREET LIGHTING

The figures and tables below provide direction on the appropriate luminaire selection and non-median lighting layout when designing an arterial street with non-continuous street. Street luminaires are to be placed in an opposite arrangement when not located at an intersection, Figures 19 and 20.

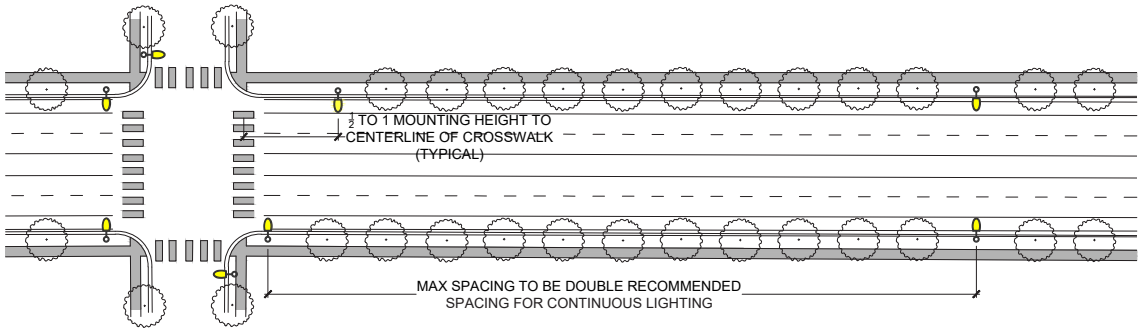

Figure 19: Typical Arterial with Non-Continuous Street Lighting Plan

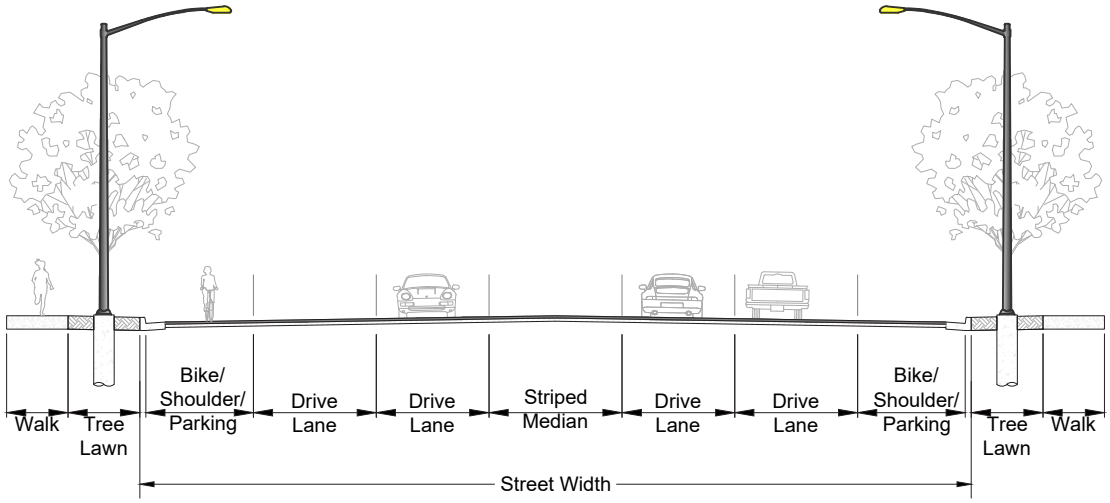

Figure 20: Typical Arterial with Non-Continuous Street Lighting Cross Section

TABLE 15: RECOMMENDED ARTERIAL (NON-MEDIAN MOUNTED) LUMINAIRE & POLE CRITERIA

STREET WIDTH	PEDESTRIAN ACTIVITY	POLE SPACING (FT)	POLE HEIGHT (FT)	LUMEN OUTPUT (LM)	TYPICAL PHOTOMETRIC DISTRIBUTION	MAX. BUG RATING
50-70	Medium	240-280	30-35	6,500-9,000	Type II or III	B2-U0-G2
		280-360	30-35	8,500-10,000	Type II or III	B2-U0-G2
	Low	360-440	30-35	6,000-8,500	Type II or III	B2-U0-G2
70-90	Medium	240-320	30-35	7,500-10,000	Type II or III	B2-U0-G2
		320-400	30-35	8,500-12,000	Type II or III	B3-U0-G2
	Low	280-360	30-35	6,500-9,500	Type II or III	B2-U0-G2
		360-440	30-35	7,500-11,000	Type II or III	B2-U0-G2
90-110	Medium	280-360	30-35	10,000-18,000	Type II or III	B2-U0-G2
		360-440	30-35	15,000-19,000	Type II or III	B3-U0-G3
	Low	280-360	30-35	8,000-13,000	Type II or III	B2-U0-G2
		360-440	30-35	12,000-14,500	Type II or III	B2-U0-G2

ARTERIAL STREET - CONTINUOUS STREET LIGHTING AND CONTINUOUS PEDESTRIAN LIGHTING

The figures and tables below provide direction on the appropriate luminaire selection and non-median lighting layout when designing an arterial street with continuous street and pedestrian lighting. Street lights are to be placed in an opposite arrangement when not located at an intersection. Pedestrian lights should be coordinated with the landscape and street lighting layouts to maintain a consistent spacing, Figures 21 and 22.

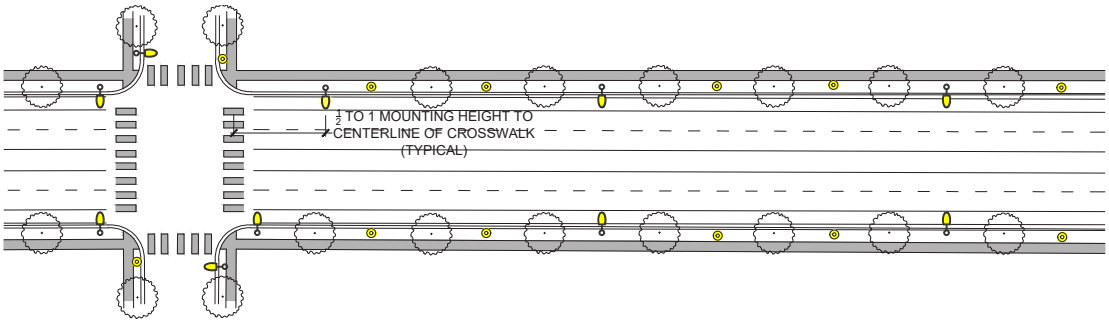

Figure 21: Typical Arterial with Continuous Street and Pedestrian Lighting Plan

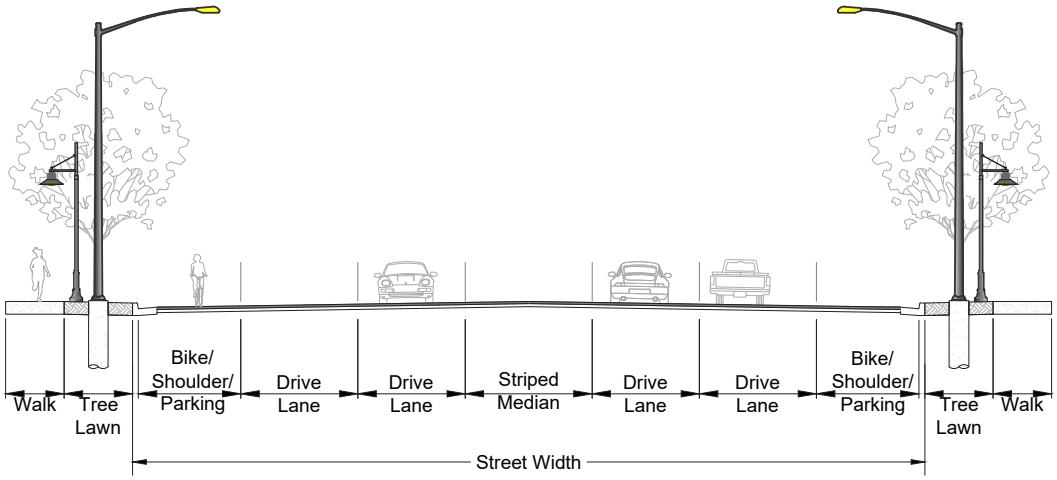

Figure 22: Typical Arterial with Continuous Street and Pedestrian Lighting Cross Section

TABLE 16: ARTERIAL STREET TARGET CRITERIA PER IES RP-8-18

PEDESTRIAN ACTIVITY	ROADWAY		SIDEWALKS
	AVERAGE LUMINANCE (CD/M2)	LUMINANCE AVG:MIN RATIO	AVERAGE ILLUMINANCE (FC)
High	1.2	3:1	1.0

TABLE 17: RECOMMENDED ARTERIAL (NON-MEDIAN MOUNTED) STREET LUMINAIRE & POLE CRITERIA

STREET WIDTH	PEDESTRIAN ACTIVITY	POLE SPACING (FT)	POLE HEIGHT (FT)	LUMEN OUTPUT (LM)	TYPICAL PHOTOMETRIC DISTRIBUTION	MAX. BUG RATING
50-70	High	120-140	30-35	6,500-9,000	Type II or III	B2-U0-G2
		140-180	30-35	8,500-14,000	Type II or III	B3-U0-G2
70-90	High	140-180	30-35	8,500-12,000	Type II or III	B2-U0-G2
		180-220	30-35	12,000-18,000	Type II or III	B3-U0-G3
90-110	High	120-160	30-35	11,000-18,000	Type II	B3-U0-G3

TABLE 18: RECOMMENDED ARTERIAL (NON-MEDIAN MOUNTED) PEDESTRIAN LUMINAIRE & POLE CRITERIA

PEDESTRIAN ACTIVITY	POLE SPACING (FT)	POLE HEIGHT (FT)	LUMEN OUTPUT (LM)	TYPICAL PHOTOMETRIC DISTRIBUTION	MAX. BUG RATING
High	50-80	12-15	3,000-5,500	Type II or III	B1-U2-G1

ARTERIAL STREET – CONTINUOUS STREET LIGHTING AND NON-CONTINUOUS PEDESTRIAN LIGHTING

The figures and tables below provide direction on the appropriate luminaire selection and non-median lighting layout when designing an arterial street with continuous street lighting and non-continuous pedestrian lighting. Street luminaires are to be placed in an opposite arrangement when not located at an intersection. Pedestrian luminaire should be located to illuminate locations shadowed by trees or at vehicle-pedestrian conflict points, Figures 23 and 24.

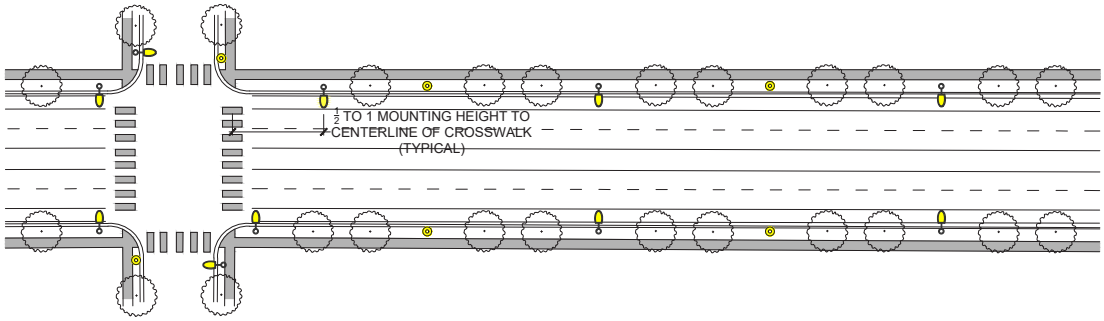

Figure 23: Typical Arterial with Continuous Street Lighting and Non-Continuous Pedestrian Lighting Plan

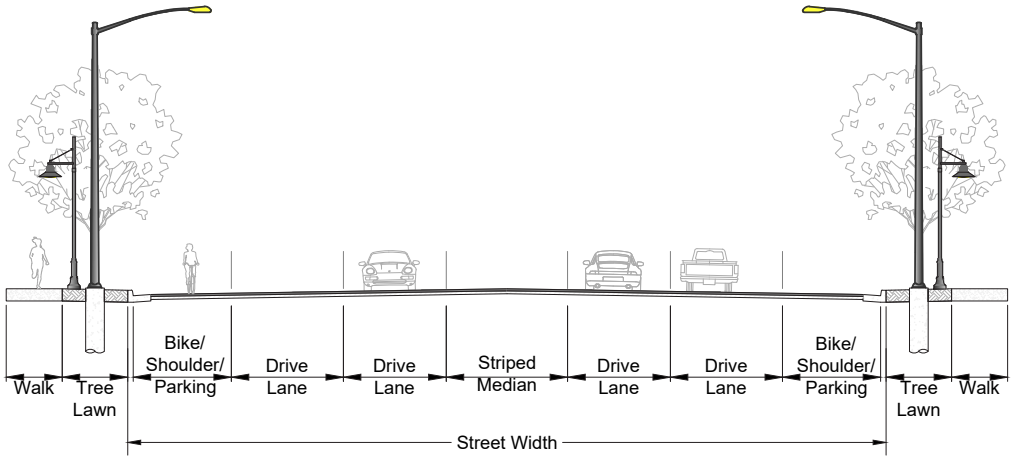

Figure 24: Typical Arterial with Continuous Street Lighting and Non-Continuous Pedestrian Lighting Cross Section

TABLE 19: ARTERIAL STREET TARGET CRITERIA PER IES RP-8-18

PEDESTRIAN ACTIVITY	ROADWAY		SIDEWALKS
	AVERAGE LUMINANCE (CD/M2)	LUMINANCE AVG:MIN RATIO	AVERAGE ILLUMINANCE (FC)
High	1.2	3:1	1.0
Medium	0.9	3:1	0.5
Low	0.6	4:1	0.4

TABLE 20: RECOMMENDED ARTERIAL (NON-MEDIAN MOUNTED) LUMINAIRE & POLE CRITERIA

STREET WIDTH (FT)	PEDESTRIAN ACTIVITY	POLE SPACING (FT)	POLE HEIGHT (FT)	LUMEN OUTPUT (LM)	TYPICAL PHOTOMETRIC DISTRIBUTION	MAX. BUG RATING
50-70	High	120-140	30-35	6,500-9,000	Type II or III	B2-U0-G2
		140-180	30-35	8,500-14,000	Type II or III	B3-U0-G2
	Medium	140-180	30-35	6,500-9,000	Type II or III	B2-U0-G2
		180-220	30-35	8,500-10,000	Type II or III	B2-U0-G2
	Low	180-220	30-35	6,000-8,500	Type II or III	B2-U0-G2
70-90	High	140-180	30-35	8,500-12,000	Type II or III	B2-U0-G2
		180-220	30-35	12,000-18,000	Type II or III	B3-U0-G3
	Medium	120-160	30-35	7,500-10,000	Type II or III	B2-U0-G2
		160-200	30-35	8,500-12,000	Type II or III	B3-U0-G2
	Low	140-180	30-35	6,500-9,500	Type II or III	B2-U0-G2
		180-220	30-35	7,500-11,000	Type II or III	B2-U0-G2
90-110	High	120-160	30-35	11,000-18,000	Type II	B3-U0-G3
	Medium	140-180	30-35	10,000-18,000	Type II or III	B2-U0-G2
		180-220	30-35	15,000-19,000	Type II or III	B3-U0-G3
	Low	140-180	30-35	8,000-13,000	Type II or III	B2-U0-G2
		180-220	30-35	12,000-14,500	Type II or III	B2-U0-G2

TABLE 21: RECOMMENDED ARTERIAL (NON-MEDIAN MOUNTED) PEDESTRIAN LUMINAIRE & POLE CRITERIA

PEDESTRIAN ACTIVITY	POLE SPACING (FT)	POLE HEIGHT (FT)	LUMEN OUTPUT (LM)	TYPICAL PHOTOMETRIC DISTRIBUTION	MAX. BUG RATING
High	50-80	12-15	3,000-5,500	Type II or III	B1-U2-G1
Medium	50-80	12-15	3,000-5,000	Type II or III	B1-U0-G1
	80-120	12-15	3,000-5,500	Type II or III	B1-U0-G1
Low	50-80	12-15	2,000-4,500	Type II or III	B1-U0-G1
	80-120	12-15	2,500-5,500	Type II or III	B1-U0-G1

ARTERIAL STREET - INTERSECTION ONLY LIGHTING

The figures and tables below provide direction on the appropriate luminaire selection and non-median lighting layout when designing an arterial street with intersection only street lighting. Street luminaires are to be placed at intersection with luminaire on half to one mounting height in front of any existing crosswalks, Figures 25 and 26.

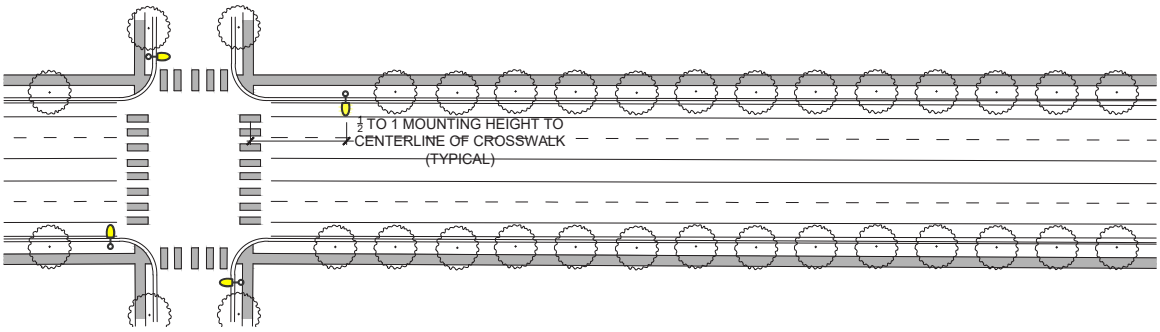

Figure 25: Typical Arterial with Street Lights at Intersections Only Plan

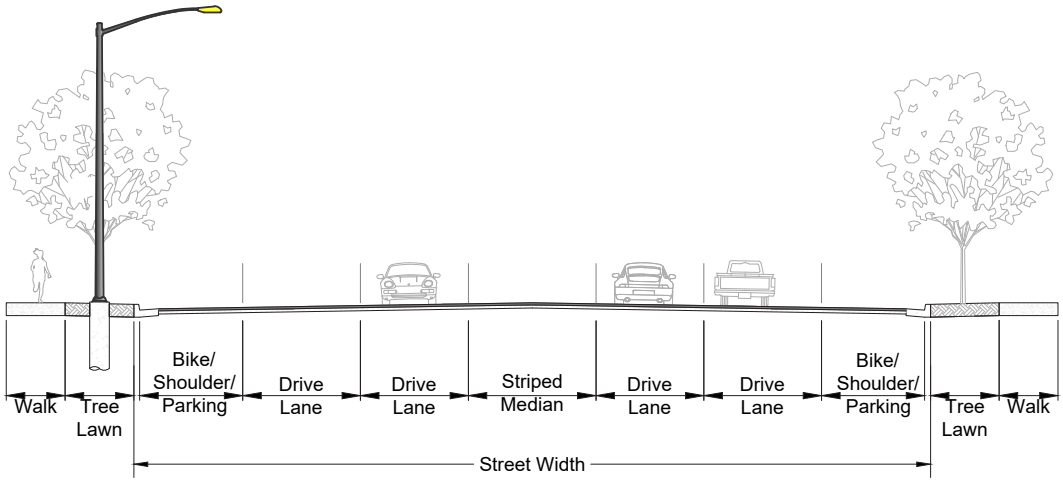

Figure 26: Typical Arterial with Street Lights at Intersections Only Cross Section

See Intersections & Crosswalks Section on page 14 for lighting criteria and luminaire recommendations.

COLLECTOR STREET – CONTINUOUS STREET LIGHTING

The figures and tables below provide direction on the appropriate luminaire selection and non-median lighting layout when designing a collector street with only street lighting. Luminaires are to be placed in an opposite arrangement when not located at an intersection, Figures 27 and 28.

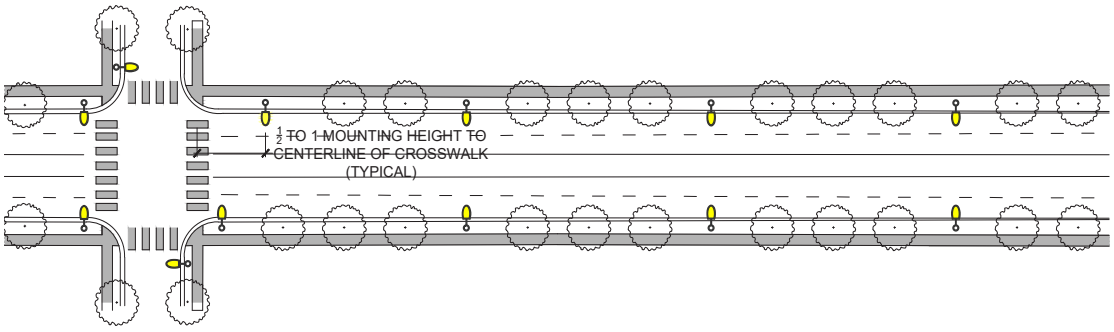

Figure 27: Typical Collector Street with Continuous Street Lighting

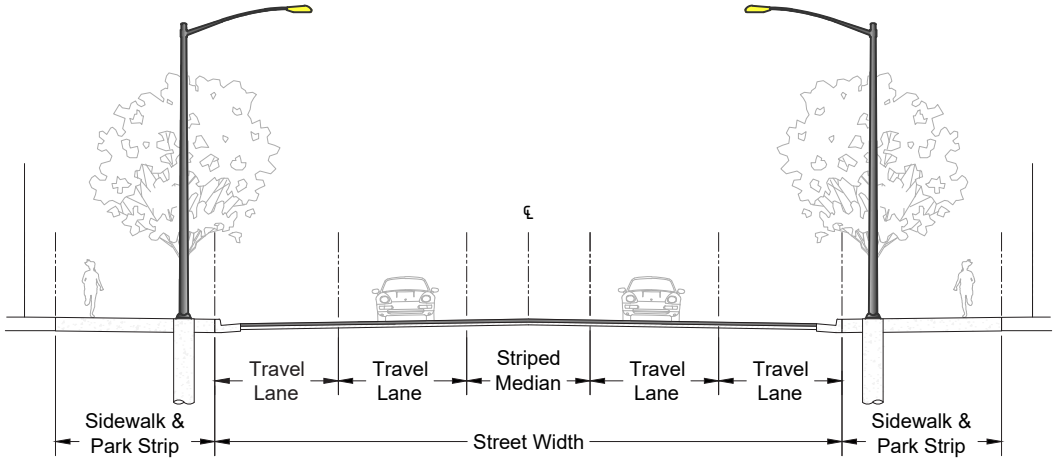

Figure 28: Typical Cross Section for Collector with Continuous Street Lighting

TABLE 22: ARTERIAL STREET TARGET CRITERIA PER IES RP-8-18

PEDESTRIAN ACTIVITY	ROADWAY		SIDEWALKS
	AVERAGE LUMINANCE (CD/M2)	LUMINANCE AVG:MIN RATIO	AVERAGE ILLUMINANCE (FC)
High	0.8	3:1	1.0
Medium	0.6	4:1	0.5

TABLE 23: RECOMMENDED COLLECTOR STREET LUMINAIRE AND POLE SPACING CRITERIA

ROADWAY WIDTH (FT)	PEDESTRIAN ACTIVITY	POLE SPACING (FT)	POLE HEIGHT (FT)	LUMEN OUTPUT (LM)	TYPICAL PHOTOMETRIC DISTRIBUTION	MAX. BUG RATING
30-50	High	140-160	30	6,500-7,800	Type II or III	B2-U0-G2
		180-220	30	7,000-10,000	Type II or III	B2-U0-G2
	Medium	140-160	30	5,000-7,000	Type II or III	B2-U0-G2
		180-220	30	6,500-8,800	Type II or III	B2-U0-G2
50-70	High	140-160	30	6,500-8,000	Type II or III	B2-U0-G2
		180-220	30	7,000-9,000	Type II or III	B2-U0-G2
	Medium	140-160	30	6,000-7,700	Type II or III	B2-U0-G2
		180-220	30	7,000-8,700	Type II or III	B2-U0-G2
70-100	High	120-140	30	8,500-12,000	Type II or III	B2-U0-G2
	Medium	140-160	30	7,000-10,000	Type II or III	B2-U0-G2
		180-220	30	9,000-13,000	Type II or III	B2-U0-G2

COLLECTOR STREET – NON-CONTINUOUS STREET LIGHTING

The figures and tables below provide direction on the appropriate luminaire selection and non-median lighting layout when designing a collector street with non-continuous street lighting. Luminaires are to be placed in an opposite arrangement when not located at an intersection, Figures 29 and 30.

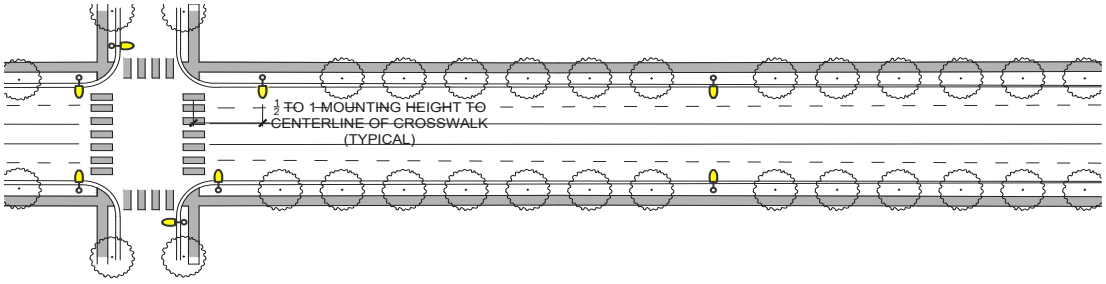

Figure 29: Typical Collector Street with Non-Continuous Street Lighting

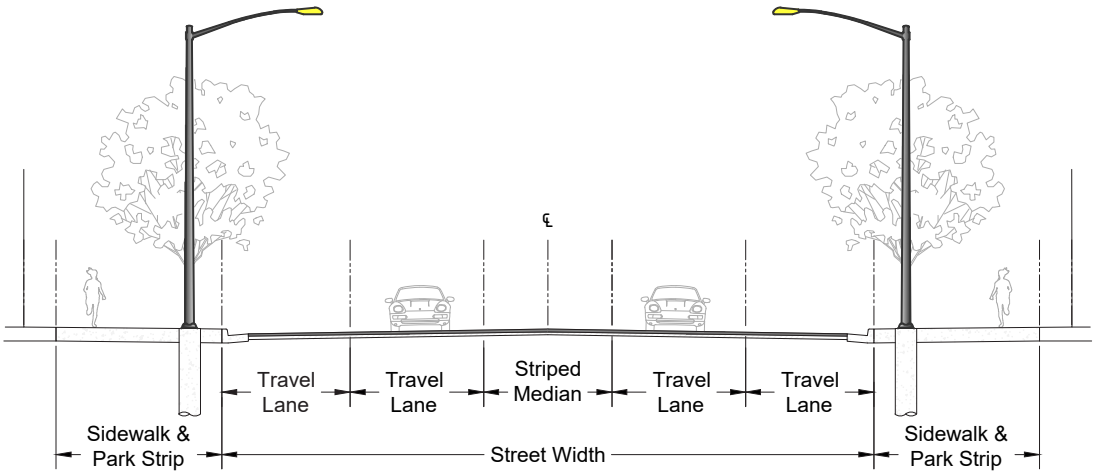

Figure 30: Typical Collector Street with Non-Continuous Lighting Cross Section

TABLE 24: RECOMMENDED COLLECTOR STREET LUMINAIRE AND POLE SPACING CRITERIA

ROADWAY WIDTH (FT)	PEDESTRIAN ACTIVITY	POLE SPACING (FT)	POLE HEIGHT (FT)	LUMEN OUTPUT (LM)	TYPICAL PHOTOMETRIC DISTRIBUTION	MAX. BUG RATING
30-50	Medium	280-320	30	5,000-7,000	Type II or III	B2-U0-G2
		320-440	30	6,500-8,800	Type II or III	B2-U0-G2
	Low	280-360	30	4,000-5,500	Type III	B1-U0-G1
		360-440	30	4,500-6,000	Type III	B1-U0-G1
50-70	Medium	280-320	30	6,000-7,700	Type II or III	B2-U0-G2
		320-440	30	7,000-8,700	Type II or III	B2-U0-G2
	Low	280-320	30	4,000-5,500	Type II or III	B2-U0-G1
		320-440	30	5,000-8,000	Type II or III	B2-U0-G2
70-100	Medium	280-320	30	7,000-10,000	Type II or III	B2-U0-G2
		320-440	30	9,000-13,000	Type II or III	B2-U0-G2
	Low	280-360	30	6,500-9,000	Type II or III	B2-U0-G2
		360-440	30	6,500-10,000	Type II or III	B2-U0-G2

COLLECTOR STREET - CONTINUOUS STREET AND CONTINUOUS PEDESTRIAN LIGHTING

The figures and tables below provide direction on the appropriate luminaire selection and non-median lighting layout when designing a collector street with continuous street and pedestrian lighting. Street luminaires are to be placed in an opposite arrangement when not located at an intersection. Pedestrian lights should be coordinated with the landscape and street lighting layouts to maintain a consistent spacing, Figures 31 and 32.

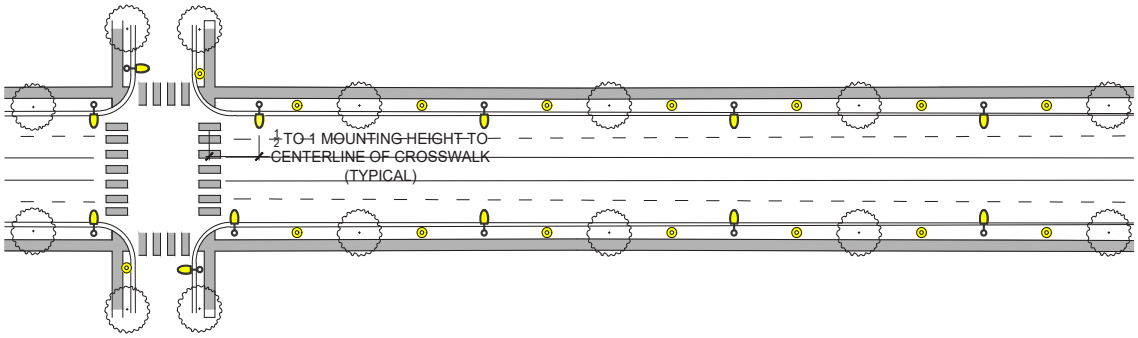

Figure 31: Typical Collector Street with Continuous Street and Pedestrian Lighting

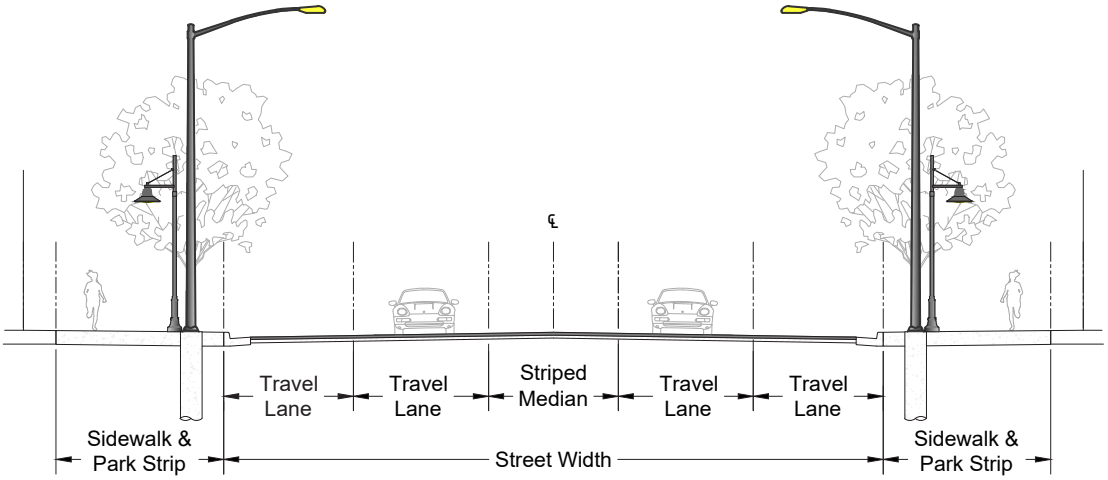

Figure 32: Typical Collector with Continuous Street and Pedestrian Lighting

TABLE 25: ARTERIAL STREET TARGET CRITERIA PER IES RP-8-18

PEDESTRIAN ACTIVITY	ROADWAY		SIDEWALKS
	AVERAGE LUMINANCE (CD/M2)	LUMINANCE AVG:MIN RATIO	AVERAGE ILLUMINANCE (FC)
High	0.8	3:1	1.0

TABLE 26: RECOMMENDED COLLECTOR STREET LUMINAIRE AND POLE SPACING CRITERIA

ROADWAY WIDTH (FT)	PEDESTRIAN ACTIVITY	POLE SPACING (FT)	POLE HEIGHT (FT)	LUMEN OUTPUT (LM)	TYPICAL PHOTOMETRIC DISTRIBUTION	MAX. BUG RATING
30-50	High	140-180	30	6,500-7,800	Type II or III	B2-U0-G2
		180-220	30	7,000-10,000		B2-U0-G2
50-70	High	140-160	30	6,500-8,000	Type II or III	B2-U0-G2
		160-220	30	7,000-9,000		B2-U0-G2
70-100	High	120-140	30	8,500-12,000	Type II or III	B2-U0-G2

TABLE 27: RECOMMENDED COLLECTOR PEDESTRIAN LUMINAIRE AND POLE SPACING CRITERIA

PEDESTRIAN ACTIVITY	POLE SPACING (FT)	POLE HEIGHT (FT)	LUMEN OUTPUT (LM)	TYPICAL PHOTOMETRIC DISTRIBUTION	MAX. BUG RATING
High	50-80	12-15	3,000-5,000	Type II or III	B1-U2-G1
	80-120	12-15	3,500-5,500	Type II or III	B1-U2-G1

COLLECTOR STREET - CONTINUOUS STREET AND NON-CONTINUOUS PEDESTRIAN LIGHTING

The figures and tables below provide direction on the appropriate luminaire selection and non-median lighting layout when designing a collector street with continuous street lighting and non-continuous pedestrian lighting. Street luminaires are to be placed in an opposite arrangement when not located at an intersection. Pedestrian luminaire should be located to illuminate locations shadowed by trees or at vehicle-pedestrian conflict points, Figures 33 and 34.

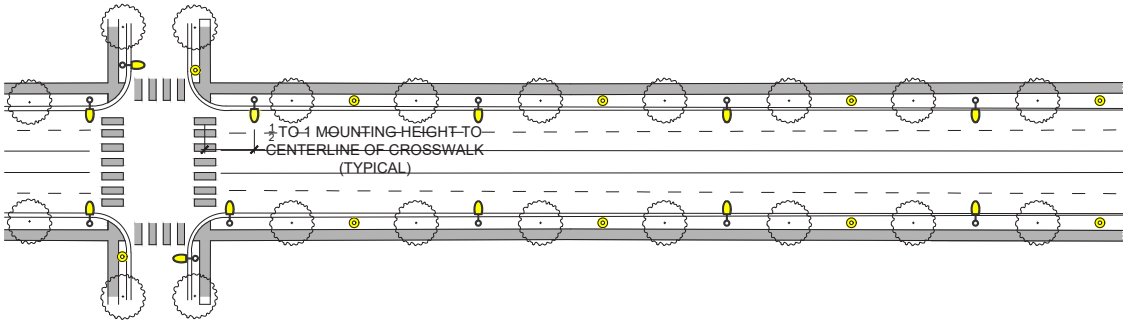

Figure 33: Typical Collector Street with Continuous Street and Non-Continuous Pedestrian Lighting Plan

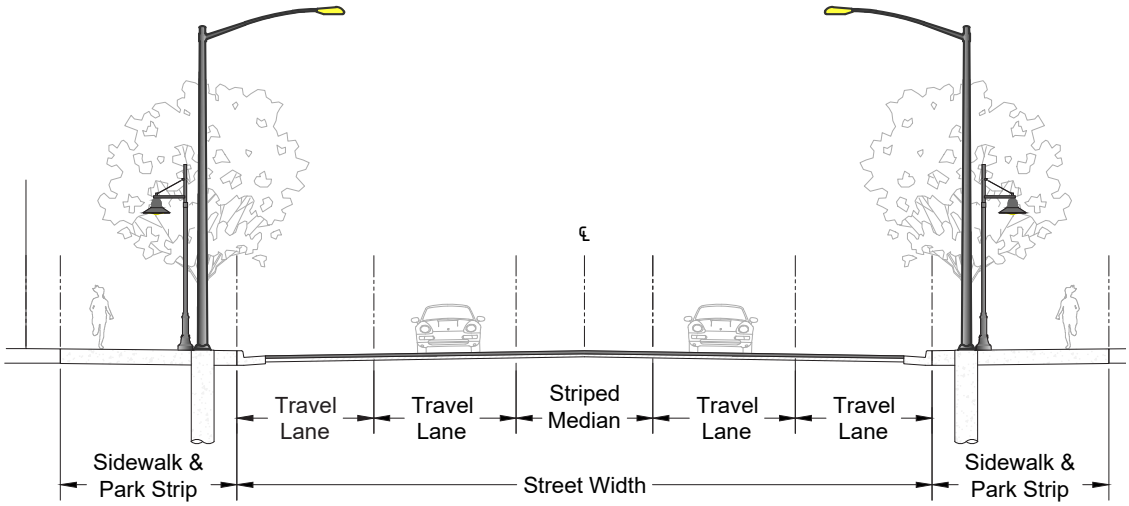

Figure 34: Typical Collector with Continuous Street and Non-Continuous Pedestrian Lighting Cross Section

TABLE 28: ARTERIAL STREET TARGET CRITERIA PER IES RP-8-18

PEDESTRIAN ACTIVITY	ROADWAY		SIDEWALKS
	AVERAGE LUMINANCE (CD/M2)	LUMINANCE AVG:MIN RATIO	AVERAGE ILLUMINANCE (FC)
High	0.8	3:1	1.0
Medium	0.6	4:1	0.5

TABLE 29: RECOMMENDED COLLECTOR STREET LUMINAIRE AND POLE SPACING CRITERIA

ROADWAY WIDTH (FT)	PEDESTRIAN ACTIVITY	POLE SPACING (FT)	POLE HEIGHT (FT)	LUMEN OUTPUT (LM)	TYPICAL PHOTOMETRIC DISTRIBUTION	MAX. BUG RATING
30-50	High	140-180	30	6,500-7,800	Type II or III	B2-U0-G2
		180-220	30	7,000-10,000	Type II or III	B2-U0-G2
	Medium	140-160	30	5,000-7,000	Type II or III	B2-U0-G2
		160-220	30	6,500-8,800	Type II or III	B2-U0-G2
50-70	High	140-160	30	6,500-8,000	Type II or III	B2-U0-G2
		160-220	30	7,000-9,000	Type II or III	B2-U0-G2
	Medium	140-160	30	6,000-7,700	Type II or III	B2-U0-G2
		160-220	30	7,000-8,700	Type II or III	B2-U0-G2
70-100	High	120-140	30	8,500-12,000	Type II or III	B2-U0-G2
	Medium	140-160	30	7,000-10,000	Type II or III	B2-U0-G2
		160-220	30	9,000-13,000	Type II or III	B2-U0-G2

TABLE 30: RECOMMENDED COLLECTOR PEDESTRIAN LUMINAIRE AND POLE SPACING CRITERIA

PEDESTRIAN ACTIVITY	POLE SPACING (FT)	POLE HEIGHT (FT)	LUMEN OUTPUT (LM)	TYPICAL PHOTOMETRIC DISTRIBUTION	MAX. BUG RATING
High	50-80	12-15	3,000-5,000	Type II or III	B1-U2-G1
	80-120	12-15	3,500-5,500	Type II or III	B1-U2-G1
Medium	50-80	12-15	2,000-4,000	Type II or III	B1-U0-G1
	80-120	12-15	2,500-5,000	Type II or III	B1-U0-G1

COLLECTOR STREET - CONTINUOUS PEDESTRIAN LIGHTING

The figures and tables below provide direction on the appropriate luminaire selection and non-median lighting layout when designing a collector street with continuous pedestrian lighting. Pedestrian lights should be coordinated with the landscape and street lighting layouts to maintain a consistent spacing, Figures 35 and 36.

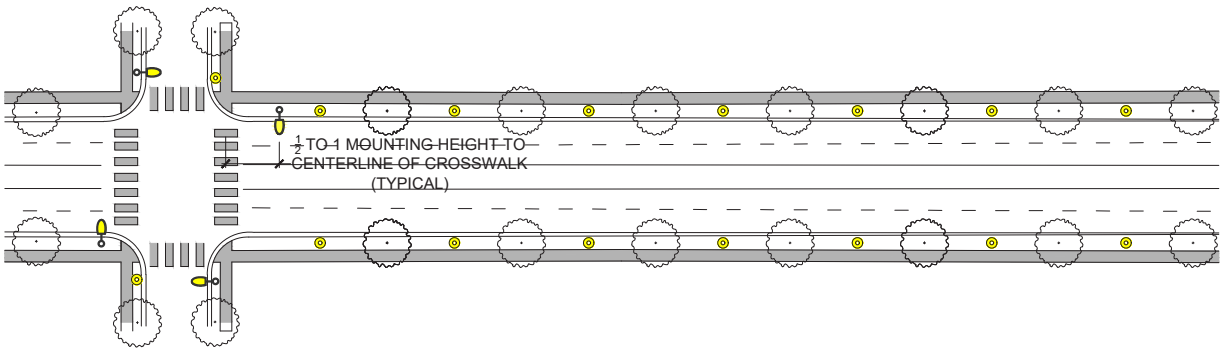

Figure 35: Typical Collector Street with Continuous Pedestrian Lighting

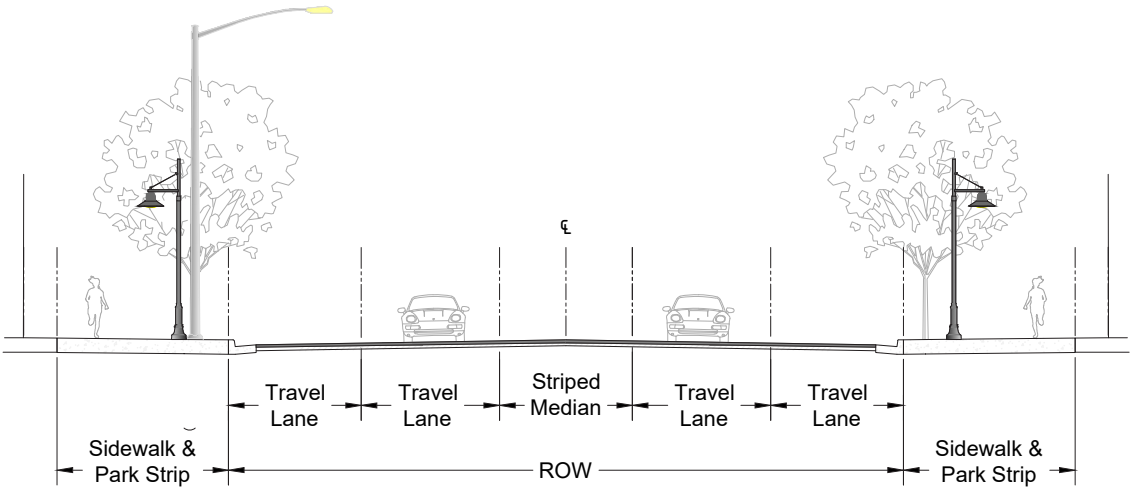

Figure 36: Typical Collector with Continuous Pedestrian Lighting

See Intersection Section on page 46 for intersection lighting criteria and luminaire recommendations.

TABLE 31: RECOMMENDED COLLECTOR PEDESTRIAN LUMINAIRE AND POLE SPACING CRITERIA

PEDESTRIAN ACTIVITY	POLE SPACING (FT)	POLE HEIGHT (FT)	LUMEN OUTPUT (LM)	TYPICAL PHOTOMETRIC DISTRIBUTION	MAX. BUG RATING
High	50-80	12-15	3,000-5,000	Type II or III	B1-U0-G1
Medium	50-80	12-15	2,000-4,000	Type II or III	B1-U0-G1

COLLECTOR STREET - NON-CONTINUOUS PEDESTRIAN LIGHTING

The figures and tables below provide direction on the appropriate luminaire selection and non-median lighting layout when designing a collector street with street lighting at intersections and non-continuous pedestrian lighting. Street luminaires are to be placed at intersection with luminaire on half to one mounting height in front of any existing crosswalks. Pedestrian luminaire should be located to illuminate locations shadowed by trees or at vehicle-pedestrian conflict points.

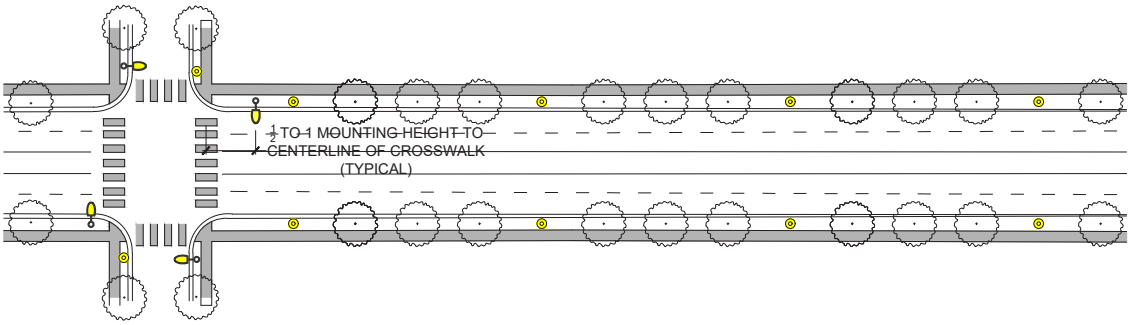

Figure 37: Typical Collector Street with Non-Continuous Pedestrian Lighting Plan

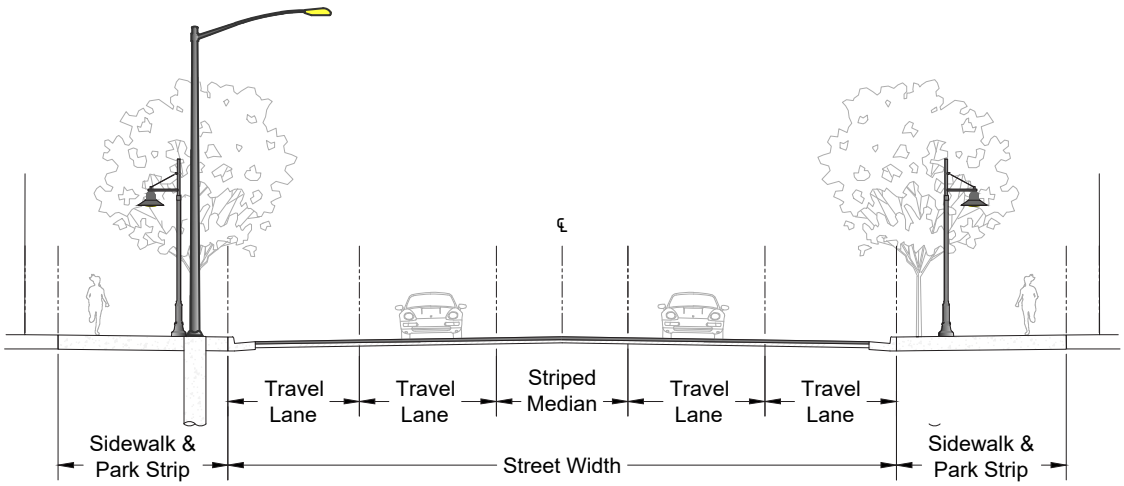

Figure 38: : Typical Collector with Non-Continuous Pedestrian Lighting Cross Section

See Intersections and Crosswalks section on page 14 for intersection lighting criteria and luminaire recommendations.

TABLE 32: RECOMMENDED COLLECTOR PEDESTRIAN LUMINAIRE AND POLE SPACING CRITERIA

PEDESTRIAN ACTIVITY	POLE SPACING (FT)	POLE HEIGHT (FT)	LUMEN OUTPUT (LM)	TYPICAL PHOTOMETRIC DISTRIBUTION	MAX. BUG RATING
Medium	80-120	12-15	2,500-5,000	Type II or III	B1-U2-G1
Low	80-120	12-15	2,500-4,000	Type II or III	B1-U0-G1

COLLECTOR STREET - STREET LIGHTING AT INTERSECTIONS ONLY

The figures and tables below provide direction on the appropriate luminaire selection and non-median lighting layout when designing a collector street with street lighting at intersections and non-continuous pedestrian lighting. Street luminaires are to be placed at intersection with luminaire on half to one mounting height in front of any existing crosswalks, Figures 39 and 40.

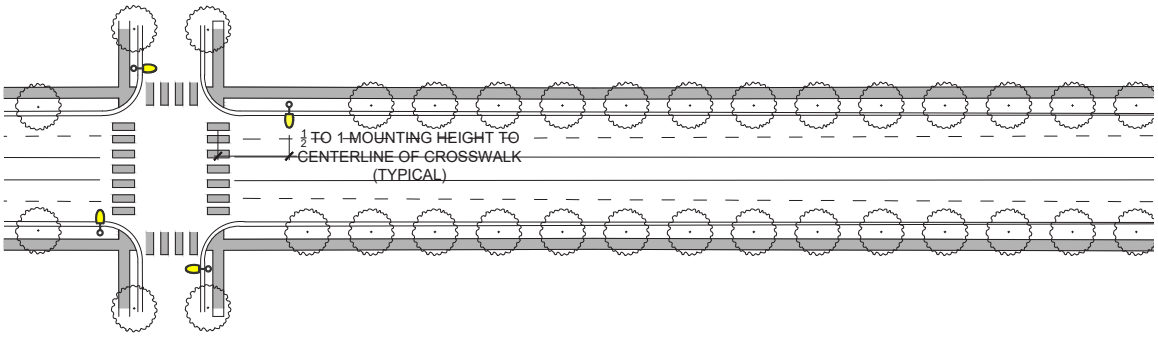

Figure 39: Typical Collector with Street Lighting at Intersections Only Plan

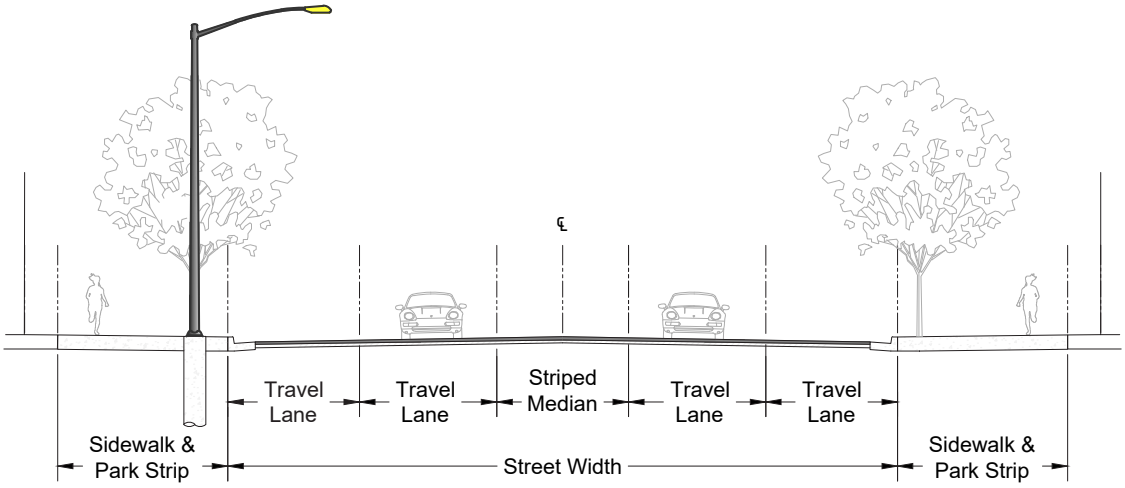

Figure 40: Typical Collector with Street Lighting at Intersections Only Cross Section

See Intersections & Crosswalks Section on page 14 for intersection lighting criteria and luminaire recommendations.

LOCAL STREET - CONTINUOUS STREET LIGHTING

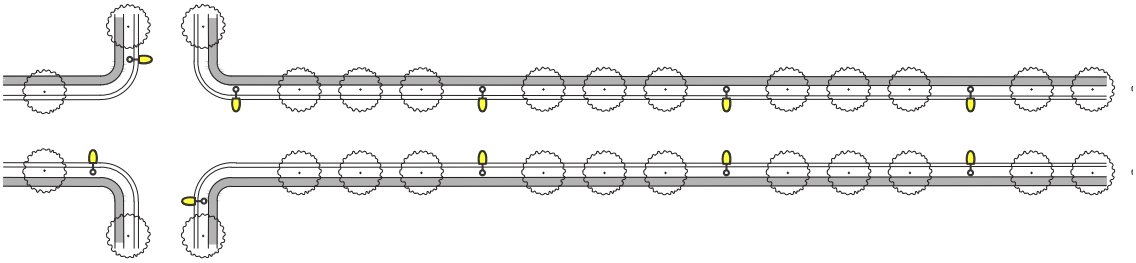

Figure 41: Typical Local Continuous Street Lighting Layout

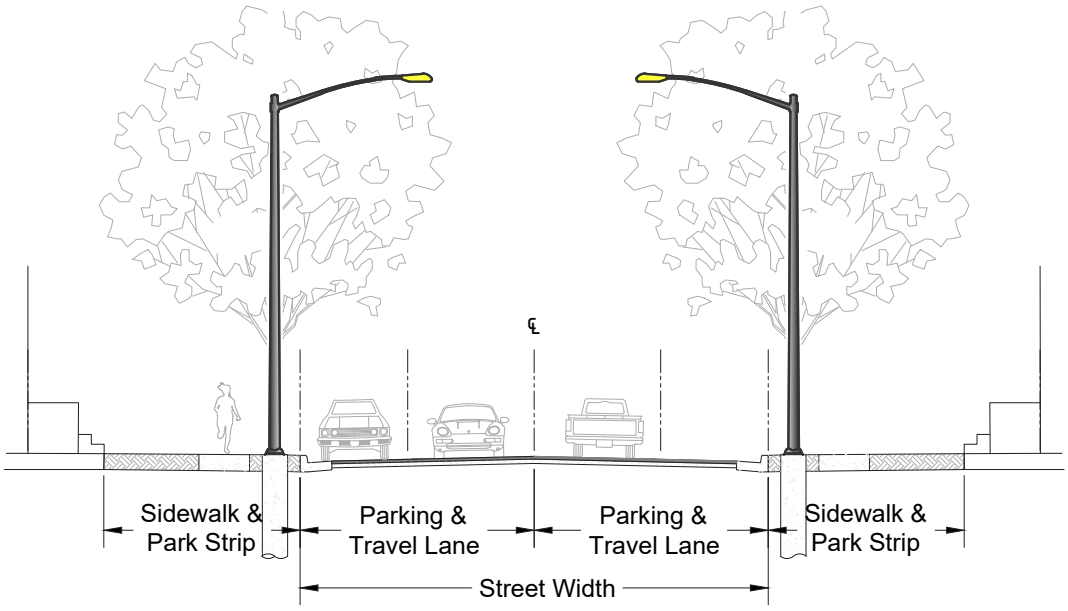

Figure 42: Typical Local Continuous Street Lighting Cross Section

TABLE 33: LOCAL STREET TARGET CRITERIA PER IES RP-8-18

PEDESTRIAN ACTIVITY	ROADWAY		SIDEWALKS
	AVERAGE LUMINANCE (CD/M2)	LUMINANCE AVG:MIN RATIO	AVERAGE ILLUMINANCE (FC)
High	0.6	6:1	1.0

TABLE 34: RECOMMENDED LOCAL STREET LUMINAIRE CRITERIA

STREET WIDTH (FT)	PEDESTRIAN ACTIVITY	POLE SPACING (FT)	POLE HEIGHT (FT)	LUMEN OUTPUT (LM)	TYPICAL PHOTOMETRIC DISTRIBUTION	MAX. BUG RATING
30-50	High	140-180	30	4,500-5,500	Type II or III	B1-U0-G1
		180-220	30	4,500-7,750	Type II or III	B2-U0-G1
50-80	High	120-160	30	4,500-7,000	Type II or III	B1-U0-G1
		160-200	30	5,500-8,250	Type II or III	B2-U0-G1

LOCAL STREET - NON-CONTINUOUS STREET LIGHTING

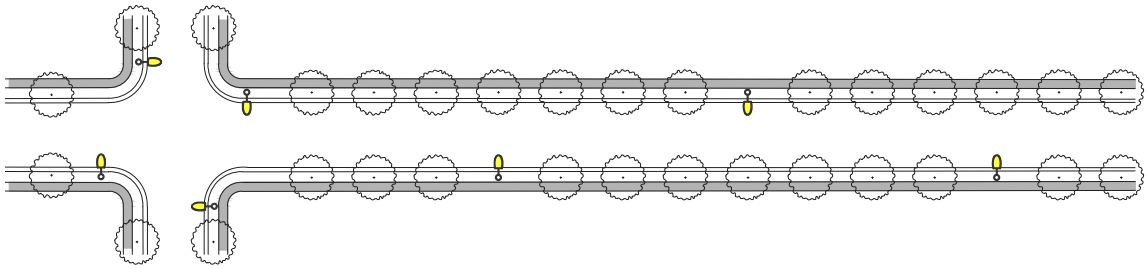

Figure 43: Typical Local Street with Non-Continuous Street Lighting Plan

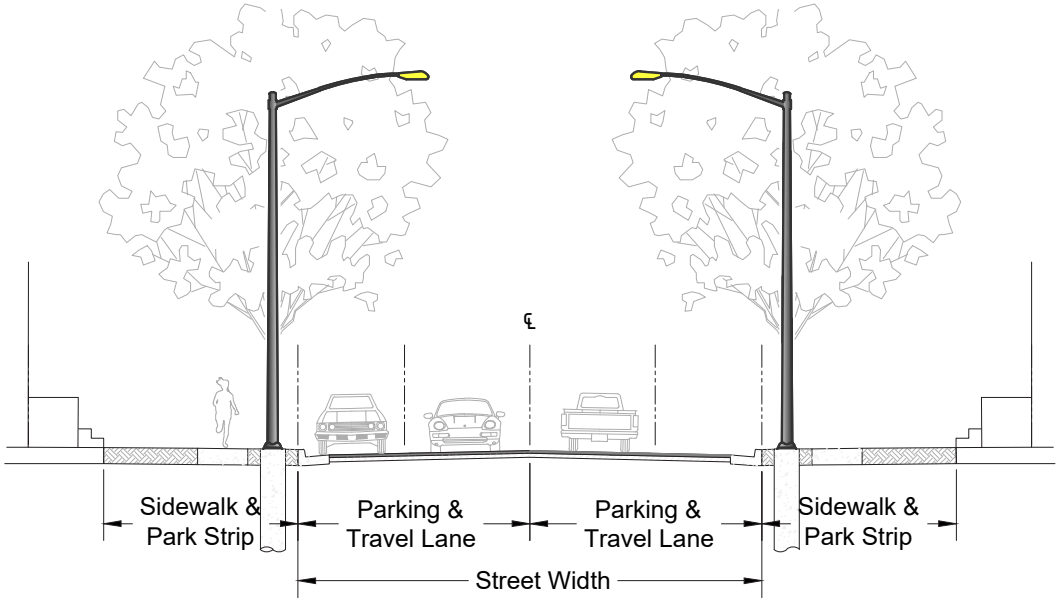

Figure 44: Typical Local Street with Non-Continuous Street Lighting Cross Section

TABLE 35: RECOMMENDED LOCAL STREET LUMINAIRE CRITERIA

STREET WIDTH (FT)	PEDESTRIAN ACTIVITY	POLE SPACING (FT)	POLE HEIGHT (FT)	LUMEN OUTPUT (LM)	TYPICAL PHOTOMETRIC DISTRIBUTION	MAX. BUG RATING
30-50	High	280-360	30	4,500-5,500	Type II or III	B1-U0-G1
		360-440	30	4,500-7,750	Type II or III	B2-U0-G1
	Medium	320-440	30	4,000-5,500	Type II or III	B1-U0-G1
50-80	High	240-320	30	4,500-7,000	Type II or III	B1-U0-G1
		320-400	30	5,500-8,250	Type II or III	B2-U0-G2
	Medium	300-400	30	4,500-6,000	Type II or III	B2-U0-G2

LOCAL STREET – NON-CONTINUOUS STREET LIGHTING AND CONTINUOUS PEDESTRIAN LIGHTING

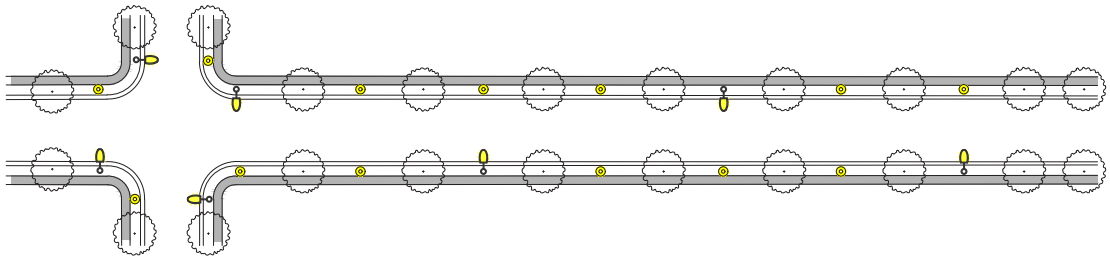

Figure 45: Typical Local Street with Non-Continuous Street and Continuous Pedestrian Lighting Plan

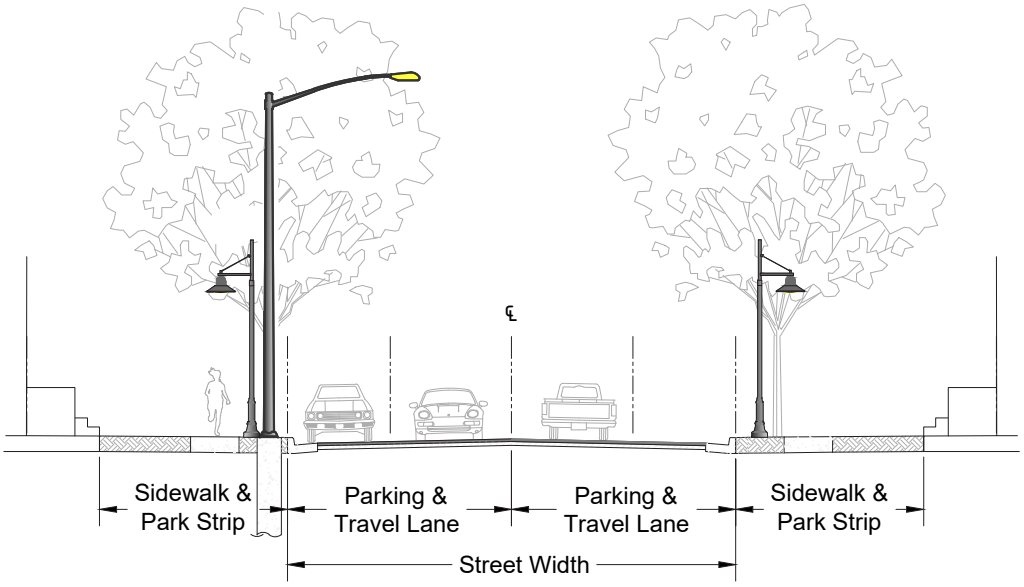

Figure 46: Typical Local Street with Non-Continuous Street and Continuous Ped Lighting Cross Section

TABLE 36: LOCAL SIDEWALK TARGET CRITERIA PER IES RP-8-18

PEDESTRIAN ACTIVITY	SIDEWALKS
	AVERAGE ILLUMINANCE (FC)
High	1.0
Medium	0.5

TABLE 37: RECOMMENDED LOCAL STREET LUMINAIRE CRITERIA

STREET WIDTH (FT)	PEDESTRIAN ACTIVITY	POLE SPACING (FT)	POLE HEIGHT (FT)	LUMEN OUTPUT (LM)	TYPICAL PHOTOMETRIC DISTRIBUTION	MAX. BUG RATING
30-50	High	280-360	30	4,500-5,500	Type II or III	B1-U0-G1
		360-440	30	4,500-7,750	Type II or III	B2-U0-G1
50-80	High	240-320	30	4,500-7,000	Type II or III	B1-U0-G1
		320-400	30	5,500-8,250	Type II or III	B2-U0-G2

TABLE 38: RECOMMENDED LOCAL PEDESTRIAN LUMINAIRE CRITERIA

STREET WIDTH (FT)	PEDESTRIAN ACTIVITY	POLE SPACING (FT)	POLE HEIGHT (FT)	LUMEN OUTPUT (LM)	TYPICAL PHOTOMETRIC DISTRIBUTION	MAX. BUG RATING
30-50	High	60-90	12	2,500-4,000	Type II or III	B1-U0-G1
		90-120	12	4,000-5,500	Type II or III	B1-U0-G1
50-80	High	60-90	12	3,500-5,500	Type II or III	B1-U0-G1

LOCAL STREET -CONTINUOUS PEDESTRIAN LIGHTING

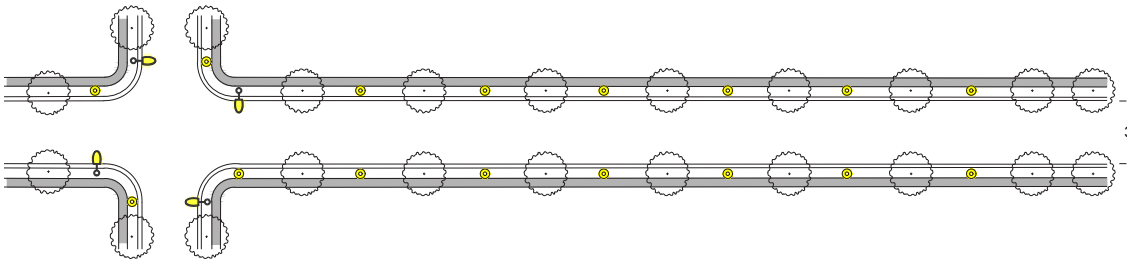

Figure 47: Typical Local Street with Continuous Pedestrian Lighting Plan

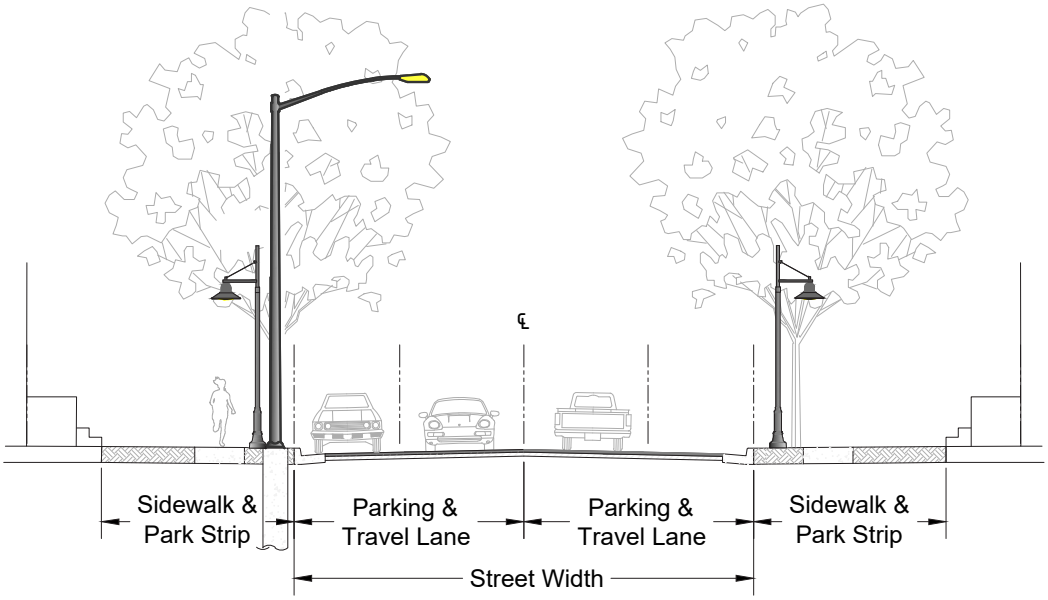

Figure 48: Typical Local Street with Continuous Pedestrian Lighting Cross Section

See Intersections and Crosswalks section on page 14 for intersection lighting criteria and luminaire recommendations.

TABLE 39: LOCAL SIDEWALK TARGET CRITERIA PER IES RP-8-18

PEDESTRIAN ACTIVITY	SIDEWALKS
	AVERAGE ILLUMINANCE (FC)
High	1.0
Medium	0.5

TABLE 40: RECOMMENDED LOCAL PEDESTRIAN LUMINAIRE CRITERIA

STREET WIDTH (FT)	PEDESTRIAN ACTIVITY	POLE SPACING (FT)	POLE HEIGHT (FT)	LUMEN OUTPUT (LM)	TYPICAL PHOTOMETRIC DISTRIBUTION	MAX. BUG RATING
30-50	High	60-90	12	2,500-4,000	Type II or III	B1-U0-G1
		90-120	12	4,000-5,500	Type II or III	B1-U0-G1
	Medium	60-90	12	2,500-3,500	Type II, III, or IV	B1-U0-G1
		90-120	12	3,500-5,500	Type II, III, or IV	B1-U0-G1
50-80	High	60-90	12	3,500-5,500	Type II or III	B1-U0-G1
	Medium	60-90	12	4,000-5,550	Type II or III	B1-U0-G1

LOCAL STREET - NON-CONTINUOUS PEDESTRIAN LIGHTING

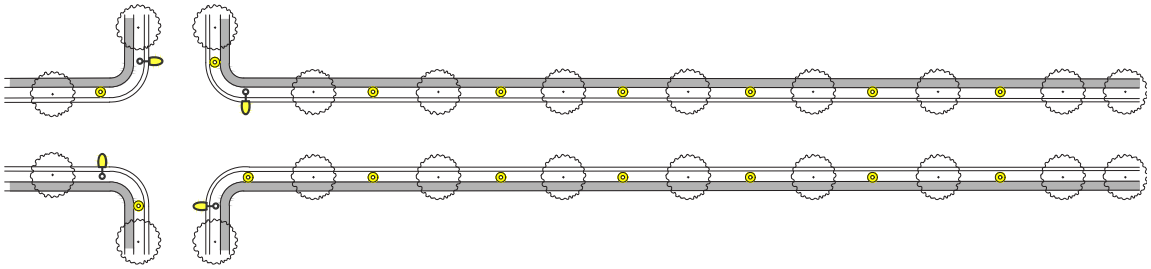

Figure 49: Typical Local Street with Non-Continuous Pedestrian Lighting Plan

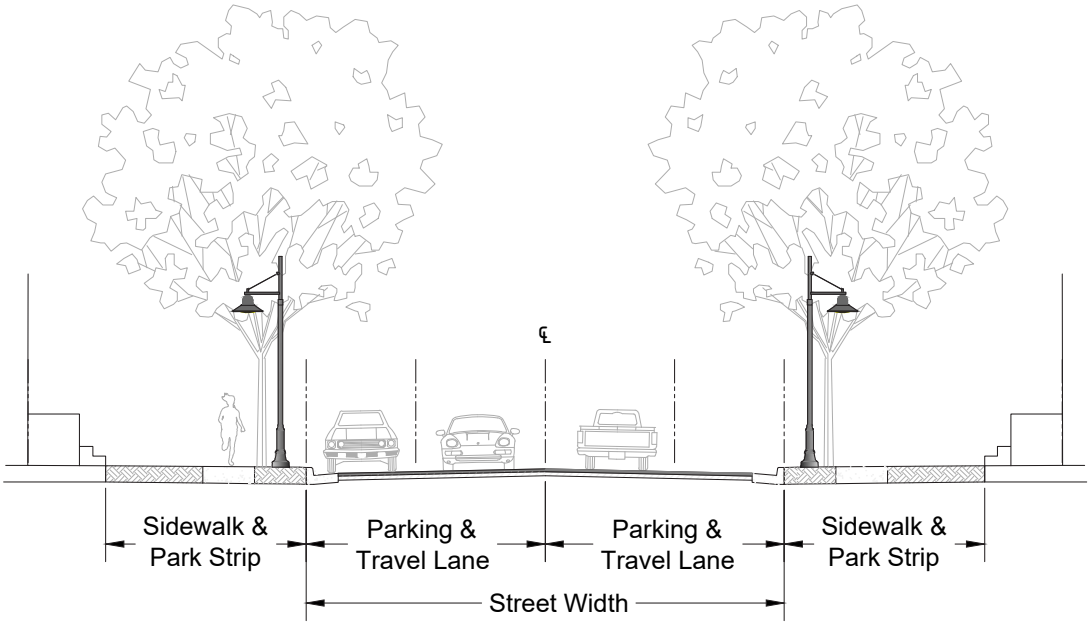

Figure 50: Typical Local Street with Non-Continuous Pedestrian Lighting Cross Section

See Intersections and Crosswalks section on page 14 for intersection lighting criteria and luminaire recommendations.

TABLE 41: RECOMMENDED LOCAL PEDESTRIAN LUMINAIRE CRITERIA

STREET WIDTH (FT)	PEDESTRIAN ACTIVITY	POLE SPACING (FT)	POLE HEIGHT (FT)	LUMEN OUTPUT (LM)	TYPICAL PHOTOMETRIC DISTRIBUTION	MAX. BUG RATING
30-50	Medium	120-180	12	2,500-3,500	Type II, III, or IV	B1-U0-G1
		180-240	12	3,500-5,500	Type II, III, or IV	B1-U0-G1
	Low	120-240	12	2,000-4,000	Type II, III, or IV	B1-U0-G1
50-80	Medium	120-180	12	4,000-5,550	Type II or III	B1-U0-G1
	Low	160-240	12	2,500-4,000	Type II, III or IV	B1-U0-G1

LOCAL STREET - INTERSECTION ONLY LIGHTING

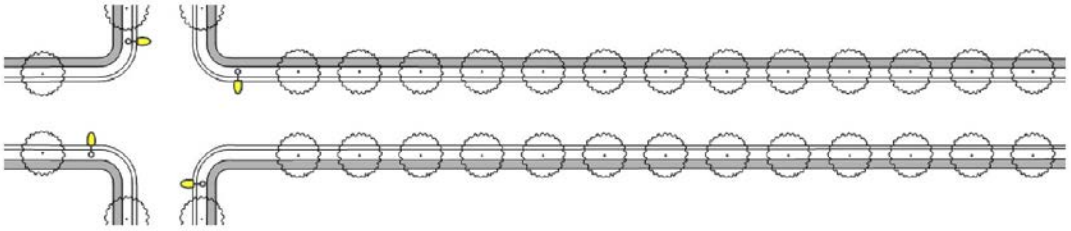

Figure 51: Typical Local Street Intersection Only Lighting Plan

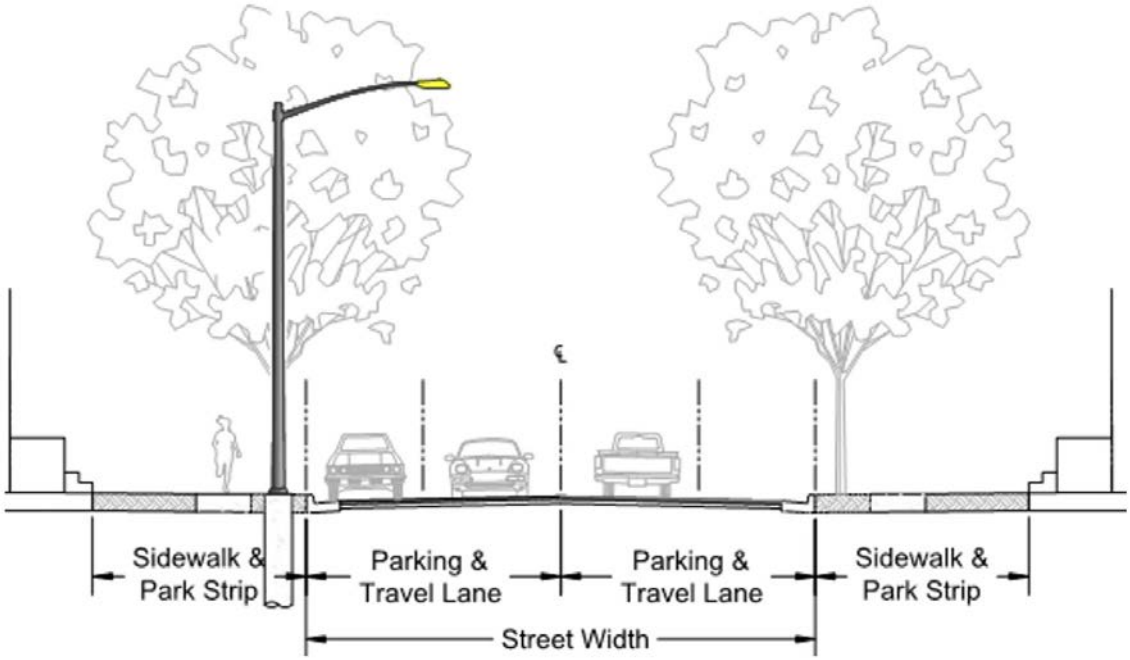

Figure 52: Typical Local Street with Intersection Only Lighting Cross Section

See Intersections and Crosswalks section on page 14 for intersection lighting criteria and luminaire recommendations.

BUS STOP LIGHTING

UNCOVERED BUS STOP

Uncovered bus stops should be lit by a street luminaire positioned 1/2 to 1 mounting height from the bus stop in the direction of oncoming traffic. The illuminance criteria at bus stops are found in Table 42.

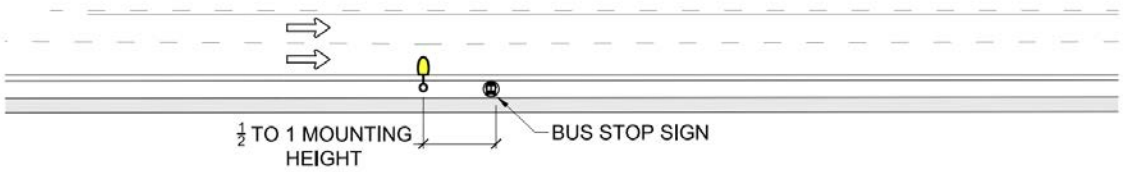

Figure 53: Uncovered Bus Stop Lighting Layout

BUS SHELTERS

Bus Shelters criteria are found in Table 42. Vertical illuminance aids in facial recognition and visible comfort and is to be measured 5 ft. above the ground. Street luminaires within 100 ft of bus shelters increase ambient light and visual comfort.

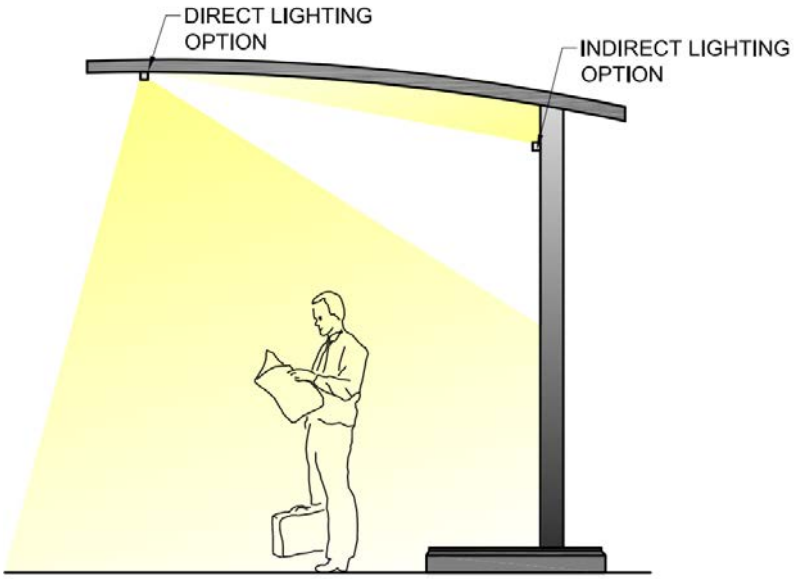

Figure 54: Covered Bus Stop Lighting Section

TABLE 42: LOCAL SIDEWALK TARGET CRITERIA PER IES RP-8-18

BUS STOP CRITERIA	HORIZONTAL ILLUMINANCE (FC)	VERTICAL ILLUMINANCE (FC)
Uncovered Bus Stop	1.0	0.2
Covered Bus Stop	1.0	1.0

MINIMAL IMPROVEMENTS

CONFIRM EXISTING CONDITIONS

Current existing conditions where improvements are being made should be evaluated prior to beginning lighting improvement design. One-for-one replacements should be done where the existing lighting strategy meets the required lighting strategy in the Lighting Warrants Table 1-3. If the existing lighting strategy is appropriate, the spacing of the existing lights should be upgraded to meet the lumen requirements for the specific type and land use and the necessary infrastructure, such as wiring, foundation, and poles are all in good condition. If the lighting strategy in the area requires additional street or pedestrian lights, supplemental improvements will need to be made. Supplemental improvements may also need to be made if the spacing is not met or there are infrastructure issues.

SUPPLEMENTAL IMPROVEMENTS

Supplemental improvements entail adding a limited quantity of new street or pedestrian light locations to the existing lighting system to illuminate any dark areas on the street. If any of the following conditions exist, then the improvement area should follow the comprehensive improvement methodology:

- The existing lighting on the block does not meet the lighting strategy in Tables 1-3: Lighting Warrants and additional pedestrian or streetlights are necessary to comply with the appropriate lighting strategy.
- Existing street or pedestrian light spacing exceeds two times the recommended value based on lighting strategy.
- Lighting only exists on one side of the street and does not sufficiently light the whole street.

.

To maintain consistency in the lighting design, all luminaires used in supplemental improvements should match the luminaires chosen for 1-for-1 replacements.

ONE-FOR-ONE REPLACEMENT

Salt Lake City is upgrading existing HID lights to new energy efficient LEDs. The new replacement lights should meet the lighting criteria set forth in the Luminaire Criteria Tables based on street classification, adjacent land use and pedestrian conflict. The City is also working to upgrade any previously installed LEDs that are not within the luminaire specification and are causing obtrusive glare and light trespass to a luminaire that is more appropriate to the specific location. All one-for-one replacements should match the appreciate color temperature based on adjacent land use and existing LEDs that do not meet the appropriate CCT should be considered for replacement.

As part of the lighting upgrades throughout the city, the new LED lights will be compatible with

LIGHTING CONTROLS AND ADAPTIVE DIMMING STRATEGIES

a city-wide wireless lighting control system. This lighting control system will allow Salt Lake City to have precise control over each individual light throughout the City, enabling the City to raise or lower light levels when needed or desired. Dimming strategies will vary throughout the City based on adjacent land use, pedestrian conflicts, and time of day to ensure vehicle and pedestrian safety while working to minimize light pollution and light trespass.

When dimming lighting in a certain area, the lighting strategy must be considered, speed limit on the streets, and vehicle and pedestrian volumes.

- When dimming continuous street or pedestrian lighting the first strategy is to dim from high or medium pedestrian criteria to medium or low pedestrian criteria. If continuous lighting is already in a low pedestrian area, research supports that when using broad spectrum LED sources, dimming to 70% of current output or lower can still provide sufficient lighting. If the City is interested in dimming below a low pedestrian criteria for a certain continuously lighted street, the City should undergo a public engagement pilot study with residents, city council, police, fire, and the city attorney to further understand the implications of reduced lighting in the area.
- Along streets with non-continuous street and pedestrian lighting, there is not a required lighting criteria and lights should be dimmed to comfortable levels while still maintaining the desired effect of the lighting design.

DIMMING IN RESIDENTIAL AREAS:

All street classifications are found in all single-and multi-family residential areas in Salt Lake City. The Table below summarizes the recommended dimming strategies based on street classification, and pedestrian conflict.

TABLE 43: RECOMMENDED DIMMING STRATEGIES FOR RESIDENTIAL AREAS

	ARTERIAL STREET	COLLECTOR STREET	LOCAL STREET
Multifamily Residential (Med Ped Conflict)	Dim Street and Pedestrian Lights to Low Ped Conflict	Dim Street and Pedestrian Lights to Low Ped Conflict	Dim Street and Pedestrian Lights to Low Ped Conflict
Single Family Residential (Low Ped Conflict)	*Dim Street and Pedestrian Lights to Comfortable Light Levels	*Dim Street and Pedestrian Lights to Comfortable Light Levels	*Dim Street and Pedestrian Lights to Comfortable Light Levels

*Dimming to comfortable light levels below the Low Pedestrian Criteria requires a public engagement process.

DIMMING IN DOWNTOWN RESTAURANT/RETAIL ENVIRONMENTS

It is essential to maintain proper light levels based on pedestrian conflict when adjusting light levels in the downtown. Pedestrian traffic fluctuates based on the night of the week, as well as the time of day. If an event is happening within a public gathering space or venue, higher pedestrian volume should be expected, and the recommended dimming strategy should be overruled and the areas surrounding the event center should be lighted to criteria. The table below shows the dimming strategies based on night of the week and time of night.

TABLE 44: RECOMMENDED DIMMING STRATEGIES FOR DOWNTOWN

		DIMMING STRATEGY
Sunday Night - Wednesday Night	Dusk to 10PM	Light to Criteria
	10PM to Midnight	Reduce Criteria to a Lower Pedestrian Conflict
	Midnight to 2:30AM	Reduce Criteria to Low Pedestrian Conflict or to Comfortable Light Levels
	2:30AM to Dawn	Reduce Criteria to Low Pedestrian Conflict or to Comfortable Light Levels
Thursday Night - Saturday Night	Dusk to 10PM	Light to Criteria
	10PM to Midnight	Reduce Criteria to a Lower Pedestrian Conflict
	Midnight to 2:30AM	Light to Criteria
	2:30AM to Dawn	Reduce Criteria to Low Pedestrian Conflict or to Comfortable Light Levels

*Dimming to comfortable light levels below the Low Pedestrian Criteria requires a public engagement process

DIMMING INTERSECTION AND MID-BLOCK CROSSINGS

Intersections and mid-block crossing should be dimmed separately from the rest of the streetlights; however, the same strategy should be used. If the intersection or crossing has less traffic at certain times throughout the night, the criteria can be reduced to a lower pedestrian conflict criteria. If further reduction in light levels are desired, a similar public engagement process should be done to ensure the safety of pedestrians and vehicles at intersection and mid-block crossings.

LUMINAIRE SPECIFICATIONS

Luminaire specifications are found in Tables 55 & 56

TABLE 55: SPECIFICATION OVERVIEW

CONTROLS	ELECTRICAL SYSTEM
Integral 0-10V dimmable drivers in order to adjust light levels. All streetlights will be installed with an ANSI 7 pin photocell receptacle to be compatible with wireless controls in the future.	Single phase 120/240V electrical system voltage.
LIGHT STANDARD SPECIFICATION	**LIGHT STANDARD FOUNDATIONS**
The light standard - also referred to as the pole - should be tapered, round galvanized steel with a 12-inch bolt circle. Color match the head and arm of the pole. Design replacement poles, heads, and/or arms to match existing color and type of adjacent poles if appropriate and with written City approval. City approval of decorative or non-standard poles is required. Painted over galvanized is required for any pole requiring color change. All new mast arm installations are required to be 2, 6, or 10 feet. The City must approve all poles with banner arms and power receptacles.	City standard design for all precast concrete or poured-in-place light standard foundations. While the City accepts poured-in-place foundations, precast concrete foundations are preferred and should be installed whenever possible.

TABLE 56: LUMINAIRE SPECIFICATIONS

LUMINAIRE	Correlated Color Temperature (CCT)	3000K Maximum
	Color Rendering Index (CRI)	≥65 in most areas, or > 40 in Critical Wildlife Habitat
	Luminaire Lumen Range	The lumen output should comply with the lumen range specified in the Recommended Luminaire Criteria Tables based on street classification, adjacent land use and pedestrian conflict. Criteria for luminaire CCT are found in Volume 1 Table 5.
	Luminaire Finish	Die cast aluminum housing with fade and abrasion resistant polyester powder coat finish. Finish should match existing color of luminaires along street.
	Luminaire Warranty	10 years on luminaire and components.
	Luminaire Warranty Period	Earliest warranty period allowed starts on the date of receipt by City.
	Luminaire Identification	Luminaire external label per ANSI C136.15, and an interior label per ANSI C136.22 required.
	Operation and Storage Temperature	'-40°C to +40°C.
	Frequency Vibration	'Luminaire should withstand low and high frequency vibration, per ANSI C136.31, over the rated life of the light source.
	Minimum Rated Life	70,000 hours minimum at 55°C, per IES TM-21
	IP rating	IP65 or greater.
	Voltage	120/277.
	Control	Dimmable and installed with ANSI 7 pin photo receptacle to be compatible with wireless luminaires controls in the future.
	Cooling System	Passive utilizing heat sinks, convection, or conduction. Upper surfaces required to shed precipitation. Cooling fans are not allowed.
	Photocontrol	Individual multi-contact 7-pin twist lock receptacle per ANSI C136.41. Or control module.
	Electrical Immunity	Luminaire are required to meet the performance requirements specified in ANSI C136.2 for dielectric withstand, using the DC test level and configuration.
LED DRIVERS	Power Factor (PF)	Minimum of 0.9 at full input power.
	Total Harmonic Distortion (THD)	Maximum of 20 percent at full input power.
	Restriction of Hazardous Substances (RoHS)	Restriction of Hazardous Substances (RoHS) compliant drivers required.
	Surge Protection	Protection from all electrical surges with an elevated electrical immunity rating, including but not limited to lightning strikes and stray current in rebar and concrete required for all LEDs. Integral surge protection to the LED power supply required. "Elevated" (10kV/10kA) requirements per IEEE/ANSI C62.41.2 for luminaire. Manufacturer indication of failure of the electrical immunity system can possibly result in disconnect of power to luminaire required.
	Total Power Consumed in Off State	Maximum 8 watt off-state power consumption for luminaire, including driver.
	Electromagnetic interference	Electromagnetic interference: Compliance with Federal Communications Commission (FCC) 47 Code of Federal Regulations (CFR) part 15 non-consumer radio frequency interference (RFI) and/or electromagnetic interference (EMI) standards.

LIGHTING CALCULATIONS

PURPOSE

Lighting design calculations for new installations is an iterative process. The use of lighting models to calculate the luminance along streets and illuminance on sidewalks is the most efficient and accurate way to design to criteria. Light trespass calculations should also be included to limit the amount of obtrusive light in the City. This section describes the required calculations to ensure that all criteria is met for all new installations.

HOW TO SET UP A CALCULATION

The following sections document the parameters and considerations when calculating street lighting levels.

IES FILES

The first step in running a calculation is to find and download the photometric in IES file format for the specific luminaire being considered. This file is available on the manufacturer's website and can be downloaded into any lighting calculation simulation software. The IES file will contain all information for the luminaire, such as lumen output, color temperature, wattage, distribution, and voltage.

LIGHT LOSS FACTOR FOR LED

A light loss factor should be applied to every luminaire considered, to ensure that the maintained light levels will meet the target criteria. Table 57, below, lists typical light loss factors for LEDs and legacy products found throughout Salt Lake City.

TABLE 57: TYPICAL LIGHT LOSS FACTORS

LIGHT SOURCE	LUMINAIRE DIRT DEPRECIATION (LDD)	LUMINAIRE LUMEN DEPRECIATION (LLD)	TOTAL LIGHT LOSS FACTOR (LLF)
LED	0.9	0.9[7]	0.81[8]
HPS	0.9	0.9	0.81
MH	0.9	0.7	0.63
HPS: High Pressure Sodium MH: Metal Halide			

[7] Use 0.9 or LM value provided by the Manufacturer at 60,000 hours, if L70 is greater than 100,000 hours

[8] If using an LM value provided by the Manufacturer, the Total LLF is equal to 0.9 x LM60,000hr

LUMINANCE AND ILLUMINANCE CALCULATIONS

Calculations should be done in AGi32, DIALux, Visual, or comparable software, and include the following calculation grids:

- **ROADWAY LUMINANCE**
  - A calculation grid is required for every lane of traffic and oriented in the direction of travel spaced 10' OC along each lane, with two points across each lane.
  - Every section of roadway where criteria changes requires a separate calculation grid.
- **INTERSECTION ILLUMINANCE**
  - Intersection calculations done using horizontal illuminance grids that include the whole intersection, as well as all crosswalks associated with the intersections. Calculation points placed in a 5'x5' grid.
- **SIDEWALK ILLUMINANCE**
  - Horizontal sidewalk illuminance grids placed on all sidewalks, spaced every 5'-10' OC along the sidewalk with two points across the sidewalk.
- **LIGHT TRESPASS ILLUMINANCE**
  - Light trespass grids located 5' past the edge of ROW, into private property. Light trespass grids placed 5' AFF, oriented toward the street with calculation points every 5'-10' OC.
  - Light trespass calculation grids separated based on adjacent land use. If the project goes from a residential area to a commercial area, a separate light trespass calculation grid required for each section of the project.
  - If a structure is within 5' from the property line, light trespass grid to be placed on the structure, 5' AFF.
  - Light trespass values should not exceed the following:
    - Single Family Residential, Multifamily Residential, Industrial and Open Space properties: **0.1FC MAXIMUM.**
      - If this criteria is not feasible with proper shielding and distribution, a variance may be considered to allow up to 0.2Fc Maximum light trespass in residential areas. Designer will be required to submit a narrative describing the efforts to control light trespass to the City Engineer.
    - Commercial, Restaurant/Retail/Civic, and Mixed-use Residential properties: **0.3FC MAXIMUM**
- **CROSSWALK VERTICAL ILLUMINANCE**
  - Vertical illuminance grids are required in all crosswalks at 5' AFF, and oriented toward oncoming traffic (See Figure 55). Calculation points should be located along the center line of each crosswalk, placed every 5' OC.

Designers submissions to the City should include a calculation summary table for each calculation grid and include the average illuminance or luminance, maximum illuminance or luminance, minimum illuminance or luminance, and Avg:Min ratio. Calculated values may vary from criteria by no more than 10% above or below.

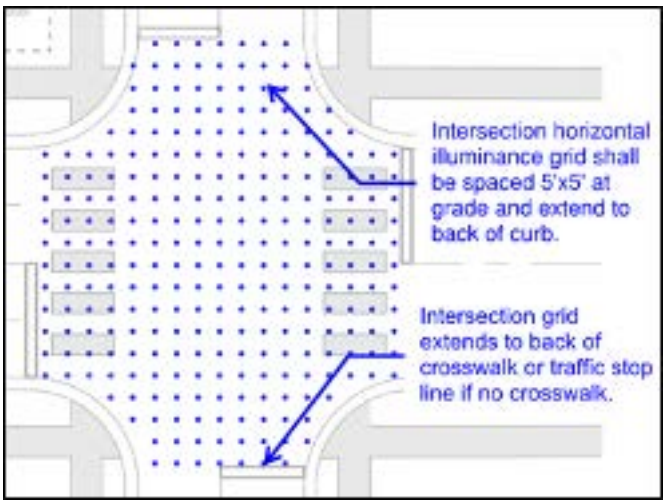

Figure 55: Horizontal Intersection Illuminance Grid

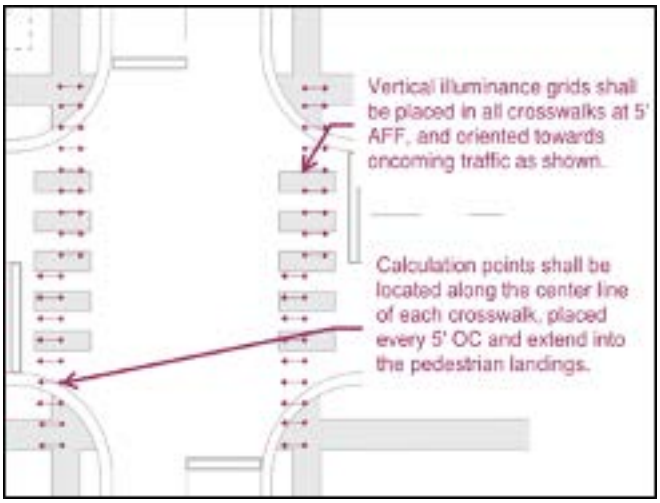

Figure 56: Vertical Intersection Illuminance Grid

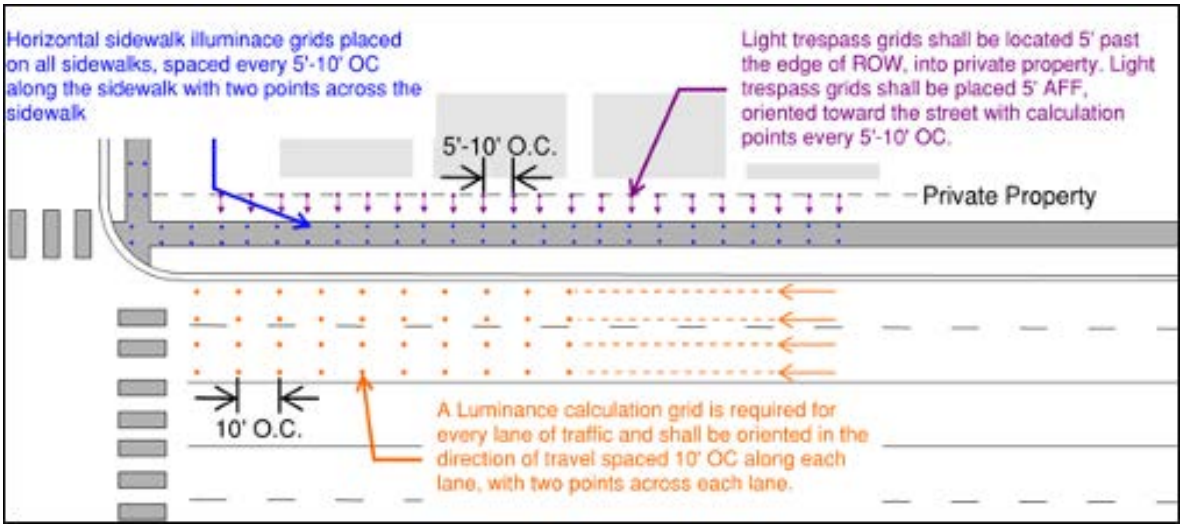

Figure 57: Roadway, Sidewalk, and Light Trespass Calculation Grid Setup